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September 3, 1963

Principal Members of X.3.2

Gentlemen:

Now that the efforts of the X.3.2 Subcommittee have resulted in the American Standard Code for Information Interchange, it is well to reflect on some aspects. The development of the Standard Code has certainly been controversial. This was predictable, since the implementation of the Standard Code will have a direct and immense effect on communications and computing equipment manufactured and marketed in the future. It was also valuable, in that I am sure we all share a common feeling that all avenues were explored, and all interested parties were heard from. The Code is admittedly a compromise of conflicting requirements, probably not ideal from the viewpoint of any single user or manufacturer, but designed to produce the greatest overall benefit to users and manufacturers working together as a group.

The IBM Corporation has felt a responsibility to describe ASCII to IBM customers, to advise them of those implications that can be foreseen, and to express IBM's support of the Standard. This has been published in a special issue of IBM's Data Processor. The Data Processor is distributed to some 50,000 individuals - customer managers and supervisors, consultants, and our own people in the field.

I take pleasure in sending you a personal copy of the Data Processor.

Yours very truly,

CEMackenzie

C. E. Mackenzie

CEM:mks

[illegible]

CBI 67/1/10

IBM

data processor

FOR CUSTOMER MANAGEMENT

volume VII number 7

THIS SPECIAL ISSUE
is devoted wholly to

ASCII*

the *American Standard Code for Information Interchange (X3.4—1963)* approved by the American Standards Association, June 17, 1963. Contents of major sections:

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PART OF THE INFORMATION in this issue is based on material released by the Business Equipment Manufacturers Association and the American Standards Association, and is used with their permission.

* You'll usually hear this pronounced as *asky*. Before official adoption, the code was frequently called *passkey* (PASCII – for Proposed American Standard Code for Information Interchange). It was also called the X3.2 code, for the subcommittee that developed the code. As noted at the top of this column, official nomenclature of the approved code includes the designation X3.4 – 1963.

accepted by the American Standards Association:

New ASA Standard Offers Coding Uniformity for Data Interchange

STANDARDS are more important to contemporary civilization than most people stop to realize. Whether established by custom, general consent, or authority, there are commonly-accepted criteria for measurements of quantity, weight, extent, value, and quality.

American industry traditionally has done a tremendous job with and through standardization. So widely and successfully has this been done, particularly over the past twenty-five years, that many of our national standards now are taken for granted. Example: screw-threads on the base of a light bulb. Other standards, like those for automobile safety glass and for the colors of traffic lights, are more consciously accepted. And in the newer technologies—space, nuclear energy, electronics, and data processing—standardization is a dynamic and continuing concern.

The first test of any standard is acceptance, and the ultimate test is continuing use. This is true whether the standard has evolved gradually, or has been developed deliberately by a group of experts through painstaking analysis, research, debate, formulation, compromise, and modification.

"American Standards"

There are now more than 2,000 *American Standards*—voluntary national standards developed and approved under the procedures of the American Standards Association (ASA). This is a privately-supported federation of 138 trade associations and professional societies and has over 2,000 member companies. Because many standards have international implications, the ASA represents American interests in international standards activities. (More details on ASA and its member groups appear on pages 8-12.)

Of 400 standards projects currently active in the ASA, a few pertaining

continued on page 2

to electronic data processing have reached a significant point in development. An example already in wide use is the magnetic-ink printed numbers and symbols along the bottom edge of bank checks. Specifications developed by the American Bankers Association are in process of becoming an American Standard.

New "American Standard" Code

A recently-adopted example is the American Standard Code for Information Interchange, officially designated as X3.4-1963 and commonly referred to as "ASCII." This standard code provides the basis for achieving coding uniformity of data interchanged between data processing and communications systems.

With ASCII as a foundation, it becomes possible to achieve eventual standardization of the specifications and formats of each of the media used for data interchange and communication. As one example, the new code's ultimate potentials for standardizing magnetic tape would mean that magnetic tapes would be completely interchangeable between different computers by standardization of both their data-encoding procedure and their physical properties (width and electro-magnetic characteristics).

Because of ASCII's significance, this issue highlights its development, structure, and implications. Included in remaining sections: reasons for a standard interchange code; ASCII's present specifications; what further work remains for the ASA standardization groups; and IBM's plans to support and implement the new code.

Introduction to Coded Character-sets

THE NEW American Standard, ASCII, was developed by a subcommittee of the American Standards Association concerned with standardization of "Coded Character Sets and Data Formats"—the subcommittee's title. Let's examine some widely-used coded character-sets and ASCII.

Coded character-sets

A coded character-set is a group of characters—such as the 26 letters of the alphabet, and numbers (0-9) and special symbols (such as %, $)—that are represented in a special way known as binary or bit (yes/no) coding. (Basic explanations of such coding terms are given in the definitions appearing on the facing page.)

Coded character-sets have existed for some time—the Morse Code being a well-known example. Many others are widely-accepted and can continue to meet the needs of specific applications. These include the following sets or codes:

Baudot Code (5 bits): for paper tape and data transmission; provides 32 characters, expandable to 58 characters by the use of shift characters.

Friden Flexowriter Code* (6 bits, plus parity and control): for paper tape; provides 64 characters.

Department of Defense Military Standard Fieldata Code (7 bits, plus parity): for paper tape, data transmission, and magnetic tape; provides 128 characters.

IBM *BCD (Binary-coded Decimal) Interchange Code* (6 bits, plus parity): for punched cards and magnetic tape; provides 64 characters.

IBM *1050 Paper-tape and Data-transmission Code* (6 bits, plus parity); provides 64 characters, expandable to 111 characters by the use of shift characters.

ASCII's coded character-set

ASCII is a coded character-set of 128 seven-bit characters. Its basic purpose is to achieve uniformity in the general interchange of information among data processing systems, communications systems, and associated equipment.

Why a Standard Code

THE CODES other than ASCII mentioned in the previous section were each designated for certain types and makes of equipment and certain applications. With the ever-increasing scope of data processing, however, their differences become more restrictive because of the growing need for data interchange between diverse types of equipment. Otherwise, the non-standard codes continue to be useful.

Many data processing applications now require computer centers to handle data from various remote points; but information at those locations may be generated by different methods and machines. Requirements for data communications often involve a wide range of terminals and multiplexers, but these may not be fully compatible.

In present systems, therefore, it is frequently necessary to translate from one code to another—for example, from a card code to a magnetic-tape code, from a paper-tape code to a transmission code, or from a card code to a processor code. In fact, the many types of codes for such interchange possibilities require many types of translation. These translations are done either by equipment or by programming.

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*Trademark of Friden, Inc.

To meet the expanding needs for information interchange most effectively, data should be directly interchangeable between all kinds of data processing, data transmission, communications, and associated devices. The means to this goal is a standard information interchange code—one that establishes a standard meaning for controls and printable data. Now, ASCII has been designated as the standard code that will achieve such uniformity.

Media qualifications

A standard code must not only provide a coded character-set but must also completely define the format of each of the media or methods (perforated tape, punched cards, magnetic tape, or data transmission) in which the interchange takes place. Without detailed definition of physical and electrical properties, as well as format, equipment manufacturers may implement the code differently in various media, and the goal of interchange is lost.

Some of the factors that must be defined for each medium in order to implement the standard code are:

continued on page 4

DEFINITIONS

OF SOME OF THE CODING TERMS USED IN THIS ISSUE

Italicized terms within definitions are defined in other definitions

BINARY CODED DECIMAL (BCD): Pertaining to a number-representation system in which each decimal digit is represented by a unique *bit-pattern.*

BINARY DIGIT: Either zero or one.

BIT: The abbreviation for *binary digit.*

BIT-PATTERN: A combination of n bits to represent 2^n possible choices; e.g., a 3-bit pattern represents 8 possible combinations, an 8-bit pattern represents 256 possible combinations, etc.

CHECK BIT: Extra *bit*(s) appended to a *bit-pattern* to help detect errors.

CODE: A set of rules used to convert data from one set of representations to another. Sometimes the set of *bit-patterns* defined by the set of rules is also called the code.

CODE CONVERSION: Translation of one *code set* to another.

CODE SET: A set of *bit-patterns* that have been derived according to the rules in a *code.*

CODED CHARACTER-SET: A group of characters to which a *code* has been assigned.

COLLATING SEQUENCE: A prescribed ordering of the characters in a *coded character-set.*

CONTIGUOUS ALPHABET: An alphabet (A through Z) assigned, by code, to a continuous binary sequence.

CONTROL CHARACTER: A character whose occurrence in a particular context initiates, modifies, or terminates a control operation.

ESCAPE CHARACTER: A *control character* to signal a change in the meaning of one or more of the characters that follow it.

GRAPHIC: A written or printed form or shape, e.g.,

3 A e % ,

GRAPHIC CHARACTER: A character which has been assigned a *graphic.*

MACHINE CODE: The internal *code* of a central processing unit.

MEDIA, MEDIUM: The configuration or material used in recording and transmitting data — e.g., punched cards, perforated tape, magnetic tape, data transmission.

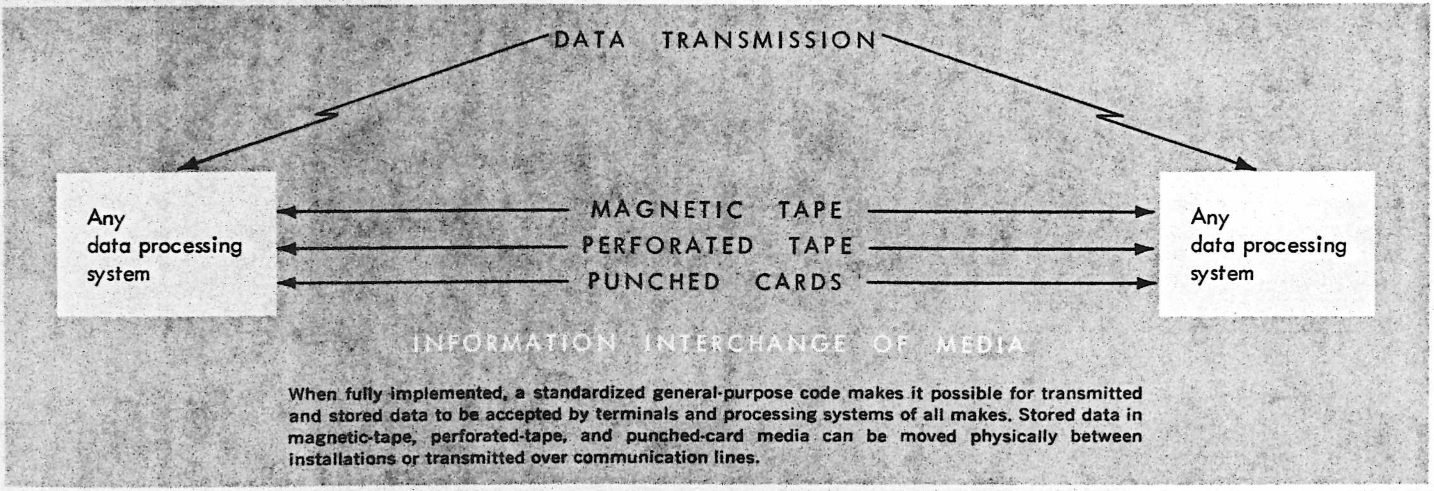
MEDIA CODES: *Code sets* assigned to media.

PARITY BIT: A type of *check bit.*

SPECIAL GRAPHIC (OR SPECIAL SYMBOL): A non-numeric or non-alphabetic character, e.g.,

( ) % @ , .

SUBSET: A set contained within a larger *code set.* ■


DATA TRANSMISSION
Any data processing system
MAGNETIC TAPE
PERFORATED TAPE
PUNCHED CARDS
Any data processing system
INFORMATION INTERCHANGE OF MEDIA

When fully implemented, a standardized general-purpose code makes it possible for transmitted and stored data to be accepted by terminals and processing systems of all makes. Stored data in magnetic-tape, perforated-tape, and punched-card media can be moved physically between installations or transmitted over communication lines.

STANDARD CODE *continued from page 3*

Punched cards—card length, width, thickness; hole size, shape, placement; relationship of holes to code bits.
Perforated tape—tape width and thickness; location of feed hole; location and size of perforations; correspondence of perforations to bits; necessity for and location of check bits.
Magnetic tape—tape width and thickness; type of recording; track width, spacing, and number; bit density; signal strength.
Data transmission—order of bits; type and location of check bits; speed; control functions.

It is also necessary that the use of each character in the code be defined. Using the code before the unassigned characters have been defined, however, may serve as valuable experience in determining what their assignments should be.

In addition, optical and magnetic character reading may have to be expanded and defined to handle all the characters of the standard code.

ASCII provides the framework which can be used to acomplish standardization, offering a solid technical basis for further work. In the next section, we'll discuss the structure of ASCII and indicate the important areas remaining for its additional definition and standardization.

ASCII's Coding Structure

ASCII* specifies the correspondence of 128 "seven-bit patterns" with 128 "graphics and controls"—the graphics for printable characters, the controls for equipment functions.

NEW X3.4-1963 AMERICAN STANDARD CODE FOR INFORMATION INTERCHANGE

ASCII	000	001	010	011	100	101	110	111
0000	NULL	DC_0 ①	ƀ	0	@	P	↑	↑
0001	SOM	DC_1	!	1	A	Q		
0010	EOA	DC_2	"	2	B	R		
0011	EOM	DC_3	#	3	C	S		
0100	EOT	DC_4 (STOP)	$	4	D	T		
0101	WRU	ERR	%	5	E	U		
0110	RU	SYNC	&	6	F	V		
0111	BELL	LEM	'	7	G	W	unassigned	unassigned
1000	FE_0	S_0	(	8	H	X		
1001	HT / SK	S_1	)	9	I	Y		
1010	LF	S_2	*	:	J	Z		
1011	V TAB	S_3	+	;	K	[		↓
1100	FF	S_4	,	<	L	\		ACK
1101	CR	S_5	-	=	M	]		②
1110	SO	S_6	.	>	N	↑		ESC
1111	SI	S_7	/	?	O	←	↓	DEL

Identification of Control Symbols and Some Graphics

NULL	Null/Idle	V TAB	Vertical tabulation	S_0-S_7	Separator (information)
SOM	Start of message	FF	Form feed	ƀ	Word separator (space, normally non-printing)
EOA	End of address	CR	Carriage return	<	Less than
EOM	End of message	SO	Shift out	>	Greater than
EOT	End of transmission	SI	Shift in	↑	Up arrow (exponentiation)
WRU	"Who are you?"	DC_0	Device control ① Reserved for data link escape	←	Left arrow (implies/replaced by)
RU	"Are you . . . ?"	DC_1-DC_3	Device control	\	Reverse slant
BELL	Audible signal	DC_4(stop)	Device control (stop)	ACK	Acknowledge
FEo	Format effector	ERR	Error	②	Unassigned control
HT	Horizontal tabulation	SYNC	Synchronous idle	ESC	Escape
SK	Skip (punched card)	LEM	Logical end of media	DEL	Delete/Idle
LF	Line feed				

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* Copies of *American Standard Code for Information Interchange (X3.4—1963)* can be obtained from the American Standards Association, Inc., 10 East 40th Street, New York 16, New York, at $1.00 per copy.

The code and its corresponding relationships are shown in the table at left. The designations for the controls are at the bottom of the table.

Reading across the table, the eight vertical columns correspond to the eight possible binary patterns of the first three bits of the code. The 16 horizontal rows correspond to the 16 possible binary patterns of the last four bits of the code.

The code consists of five major parts, each corresponding to one or more columns. These parts (reading from the left) are:

1. First two columns contain control characters.
2. Third column contains special characters.
3. Next column contains numerics, plus six special characters.
4. Next two columns contain the alphabet (upper-case), plus six special characters.
5. Two right-most columns are unassigned, except for three defined and one undefined control.

Thus, ASCII's coded character-set has 36 controls, 28 special characters, 10 numerics, and the 26 alphabetic characters—leaving 28 bit-patterns unassigned.

The fact that the different characters have been grouped by function makes it easy to distinguish between the different types of functions. To detect a control character, for example, equipment need only examine the first two bits of the bit-pattern. In many instances this will result in less circuitry.

To determine the bit-pattern corresponding to a given character (graphic or control), apply the following rules to the table:

1. Locate the graphic or control.
2. Combine the column-heading above (three bits XXX) and the row-heading at the left (four bits YYYY) into a seven-bit pattern:

(XXXYYYY)

Thus, for the graphic *A* the column-heading (at the top) is 1-0-0, and the row-heading (left) is 0-0-0-1. Therefore the seven-bit pattern for *A* is 1-0-0-0-0-0-1—the column-heading followed by the row-heading. To determine the character corresponding to a given bit-pattern, the reverse process should be applied.

The convention for specifying the bit position of each bit in the seven-bit pattern of ASCII is shown below, with the low-order position (right-most) numbered 1 and the high-order (left-most) numbered 7:

$b_7\ b_6\ b_5\ b_4\ b_3\ b_2\ b_1$

In the example for graphic *A* the code and its positional order are:

pattern —	1-0-0-0-0-0-1
positional numbering —	7-6-5-4-3-2-1

ASCII is also described as a code having a "contiguous" alphabet; this aspect is discussed elsewhere and included in the definitions list.

Using seven instead of the six bits common in other codes, ASCII points the way to an advance in the present art of coding. The 7-bit pattern providing for 128 characters is sufficient for most interchange and control needs. For those who require more characters, the ESCAPE character of ASCII provides for expansion to larger sets.

ASCII's philosophy can be summed up in three factors: seven bits, the grouping of functions, and contiguous alphabet. To use this philosophy, many details are still to be standardized. The major items to be settled are:

INCORPORATING the code into magnetic tape, punched cards, perforated tape, and data transmission.

SPECIFYING the unassigned areas, and a 4-bit subset.

DEFINING the functional meanings of the control characters.

Various working groups of the X3.2 subcommittee have been assigned to the completion of these tasks, as explained on pages 8 through 11.

IBM BCD INTERCHANGE CODE

	00	01	10	11
0000	blank	ƀ	—	& +
0001	1	/	J	A
0010	2	S	K	B
0011	3	T	L	C
0100	4	U	M	D
0101	5	V	N	E
0110	6	W	O	F
0111	7	X	P	G
1000	8	Y	Q	H
1001	9	Z	R	I
1010	0	‡	!	?
1011	# =	,	$	.
1100	@ '	% (	*	¤)
1101	:	⋎	]	[
1110	>	\	;	<
1111	√	⧻	△	ǂ

Identification of
Control Codes and Special Meanings

‡	record mark	⋎	word separator
√	tape mark	ƀ	substitute blank
△	mode change	⧻	segment mark
ǂ	group mark		

Some Comparisons of ASCII and IBM BCD Code

THE MOST commonly used code in IBM data processing systems is the IBM BCD interchange code shown on the previous page. This 6-bit code has 64 bit combinations, assigned as follows: alphabetics (26), numerics (10), special symbols (22), controls (6). Five of the special symbols have alternate, optional graphics.

In comparison, the ASCII 7-bit code has 128 bit combinations: alphabetics (26), numerics (10), special symbols (28), controls (36), unassigned (28). Other comparisons between these two codes are given in the table at right.

One difference is the number of assigned control codes. Of the 36 ASCII controls, 28 are primarily for use in data communication systems and terminals. In the BCD code, these functions are not assigned separate codes; but when required, some are provided by assigning alternate meanings to selected bit combinations.

The remaining 8 ASCII controls—S_0-S_7 information separators—are reserved primarily for data processing system use. These controls, not yet defined, may be similar to the six controls defined in the BCD interchange code.

Another important difference between the two codes is how the alphabetic characters are assigned. ASCII has the 26 alphabetics assigned in a continuous binary sequence: 1-0-0-0-0-0-1 to 1-0-1-1-0-1-0; i.e., a "contiguous" alphabet. The BCD code, on the other hand, has the alphabetics assigned in three groups which correspond to the three zone levels used to identify the alphabetics in punched cards—and they do not have a continuous binary sequence.

Code conversion between ASCII and the BCD interchange code may be accomplished by equipment, programming, or both. ■

	ASCII	IBM BCD IC
Number of bits in code	7	6
Number of characters handled	128	64
Printable graphics	64 note (1)	64 note (2)
Graphics appearing in both codes	alphabetics - 26 numerics - 10 specials - 24 . , / − + * ( ) ' & % $ # ! ? = < > ; : [ ] \ @	
Graphics appearing in ASCII - not in IBM BCD IC	↑ ← "	
Graphics appearing in IBM BCD IC - not in ASCII		⌑ △ √ ‡ Y ⧻ ⧧ note (3)
Controls	36 note (4)	6 note (3)
Lower-case alphabet	note (5)	note (5)
Checking	note (6)	note (6)

Notes

(1) This number of ASCII graphics may be increased when the 28 unassigned character codes are defined.

(2) Up to 6 of these 64 have control meanings in data processing systems.

(3) Six symbols are used to designate the 6 bit patterns which have alternate control meanings in the BCD code: △ √ ‡ Y ⧻ ⧧

(4) This number of ASCII controls may be increased when the 28 unassigned character codes are defined.

(5) At the present time neither code has specified a standard method for representing the lower case of the alphabet.

(6) Not stated as part of the code. Checking systems such as parity checking may be added.

Basic Considerations in Adopting ASCII

As further definition and standardization of ASCII proceed within the ASA working groups, each user of data processing and data-communication should be interested in the standard's effect on his operations. Although the standard's use may vary with individual operations and needs, most of the considerations necessary for adopting any new code apply in planning for ASCII.

In each installation, many factors will have to be carefully weighed to determine when it would be feasible to convert from present codes to ASCII. If the decision is made to use the standard, intensive planning is necessary.

It will probably be most advantageous to convert to new codes where there is considerable interchange of information on different types of media and between different types of equipment. Those with a small, self-contained installation who do not contemplate data interchange may decide not to convert, but such a decision should be reached only after considering the long-range potentials of standardization. It is possible that smaller applications will grow in scope and eventually require interchange both inside and outside of the application area.

Attention should be given to existing files of information, and to their sequence under present codes. If the files are small but very active, it may be most effective to convert them to the standard all at once. If the files are not active, or have moderate turn-over, the most efficient approach might be to establish dual files for interchange during the conversion period. Where interchange files are used very infrequently, it may be possible to postpone equipment modifications or changes until the files become active.

Another alternative would be to maintain the files in their present code. In this case, however, either two sets of input/output devices or translation will be needed to permit data-interchange with locations using the standard code.

In operations where numeric data are compared only with other numeric data, or alphabetic data are compared only with other alphabetic data, collating sequence of files should not present a problem. However, if intermixed classes of information are to be compared—for example, records having both alphabetic and numeric data—then collating sequence may be a problem. It should be determined if the file sequence must be altered; and, if so, what effects changing the sequence will have on procedures and applications. Collating sequence using ASCII has not yet been standardized.

Conversion to ASCII from other codes will require equipment implementation and/or computer programming. Although our first equipment specifically designed to handle the new code may be specially-engineered for a limited market, expanding usage should lead to more general equipment and/or features.

Another aspect is that the control functions of the standard code may differ from those of the previous code. Therefore, input/output equipment may have to operate in different ways using the new code's controls. This may require standardized reprogramming.

There will be many possible ways to handle the transitional period to the standard code, depending upon individual needs and applications. A data processing service or code translation bureau may be able to assist in file conversions.

No matter what approach to conversion is taken, personnel education and training should be thorough. Operators, programmers, systems personnel, and all others concerned will need to become familiar with the new standard and its application in specific operations. However, since personnel will have only one code to learn where the standard is widely used, the education and training needed with the multiplicity of present codes will no longer be necessary.

Each user of equipment will have to work out details to fit his own situation. With appropriate planning and attention, the best individual approach to code conversion, file conversion, and equipment requirements should result in improved speed and efficiency in data interchange.

Using ASCII with IBM Products

To support ASCII with input/output and Tele-processing® devices, IBM plans to provide whatever means are practical to meet customer needs for using the standard code as soon as possible after media standardization is approved by the American Standards Association.

It is expected that an ASCII standard for perforated tape will be completed first. Data-transmission, magnetic-tape, punched-card and other implementation standards will follow.

Meanwhile, to assist those customers who are planning or operating systems using ASCII in an experimental form, IBM is already providing specially-engineered features for certain products on request. These features are based

continued on page 8

USING ASCII *continued from page 7*

upon the standard code as it is implemented in these customer systems.

Our present equipment for implementation of ASCII in perforated-tape and data-transmission media:

1011 paper-tape reader and 1012 paper-tape punch attached on-line to a 1401, 1440, or 1460 system:

Both of these units handle the Baudot code and the Friden Flexowriter code (described on page 2).

To read or punch ASCII-coded tape with these units, it is necessary to provide a means for translating ASCII coding to the internal machine-language code of the data processing system to which they are connected.

Code translation for the 1011 paper-tape reader is accomplished by a control panel. On a special-request basis, IBM has available a feature that enables the 1011 to accomplish the translation from ASCII to the BCD code.

Code translation for the 1012 paper-tape punch is accomplished by programming within the DP system. In such translation, a table is used to translate from the internal processor code to the perforated-tape code. By providing the ASCII data in this table, the customer can achieve direct translation to ASCII from BCD without any modification to the 1012 equipment.

870 Document-writing System off-line conversion of: (a) perforated tape to punched cards for input to a computer; and (b) punched-card output from a computer to perforated tape for data communication:

The 870 System also operates with the Baudot and the Friden Flexowriter codes. For those customers who wish to operate with experimental systems, specially-engineered features are available for the 870 to read ASCII from perforated tape and to punch ASCII in perforated tape. All of the standard functions available on the 870, including the 866 typewriter output, can be used in conjunction with conversion operations.

7740 Communication Control System, a major new IBM TELE-PROCESSING® product that will be described in our next issue, for control of on-line data input to various data processing systems over communication lines:

The 7740 can accept data from a number of different remote terminals, including the 1050 Data-communications System and common-carrier teletype terminals (as noted in the diagram on page 10) and furnish this data directly to various IBM computers. Data from the different terminals can be transmitted to the 7740 in various codes.

continued on page 10

Developing an American Standard

Teamwork and organization resulted in ASCII

FEW IF ANY attempts at standardization have been automatic and easy. As with all specifications and usages that gain recognition as "American Standards," the new interchange code is a result of teamwork.

In addition to a great variety of requirements for this code, there was at least a normal amount of divergence—opposing views and approaches, differences of emphasis on different segments of the overall problem. Within our own organization (as there must have been in other companies), there were opposing points of view both on general approach and specific details.

Now that a national consensus is reached, there is recognition of the most important point: ASCII will have far-reaching benefits to manufacturers and users of data processing equipment.

ASA sectional committees

ASA is the national clearinghouse and coordinating agency for voluntary standards in the United States. Its organization of committees, subcommittees and working groups provides for airing of opinions from all quarters, adjudication of differences, and working out of details.

Depending on the nature and size of the problem, ASA has several well-proved organizational methods for arriving at a standard. In the case of ASCII, the "sectional committee method" was followed. The code definition fitted the scope of the *X3 Sectional Committee—Computers and Information Processing.* Membership in this committee is by national association, society, or organization, divided equally into three groups by interest (present numbers of individual members appear in parentheses): general interest organizations (10), user organizations (9), manufacturer associations (10). For a listing of membership see page 12.

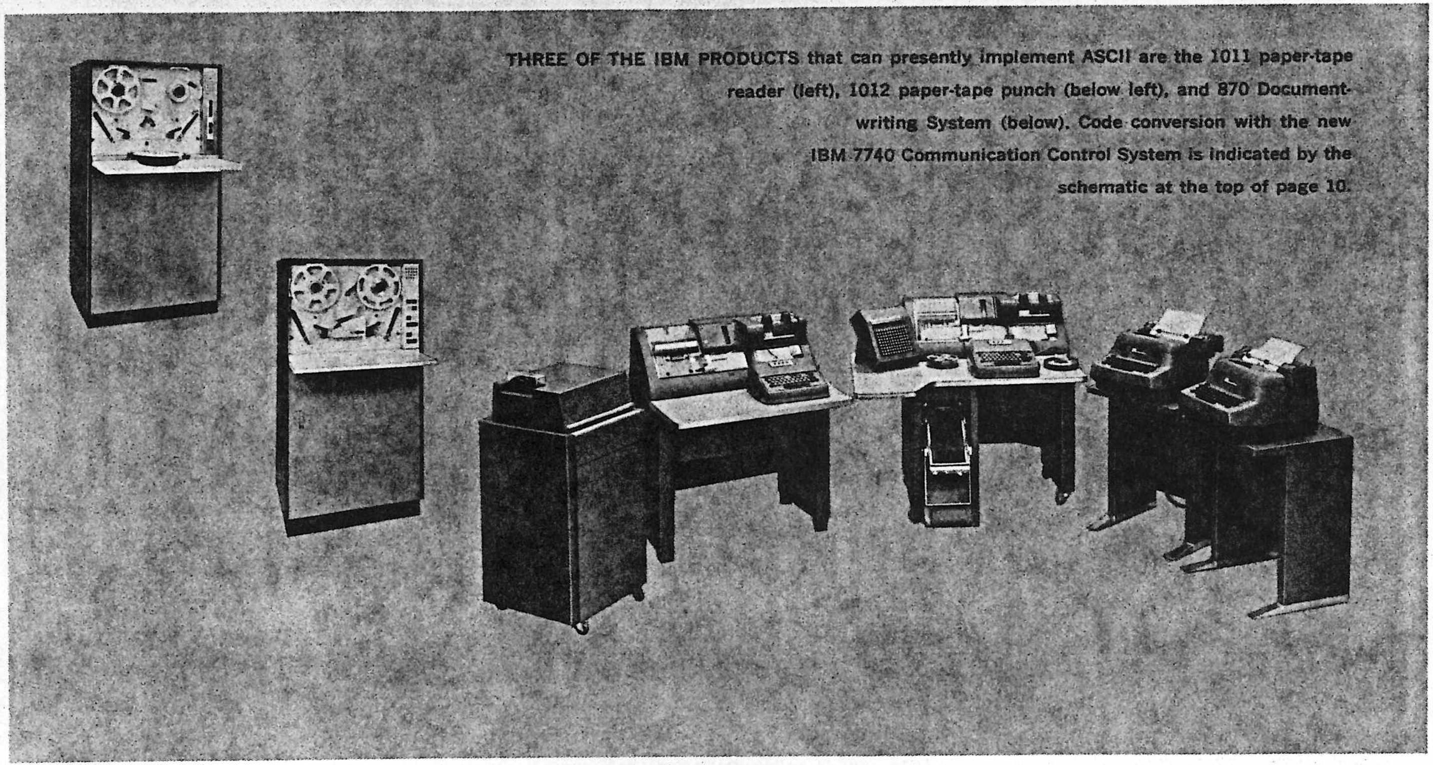
The manufacturer group is represented by the Business Equipment Manufacturers Association. The group's votes represent BEMA's position and are held by 10 member companies, selected annually. As sponsor of the X3 project, BEMA provides financing, staff, facilities and essentially all other support needed to carry out a standards program. (BEMA also sponsors the *X4 Sectional Committee—Office Machines.*)

Scope of the X3 committee (29 individuals representing 20 organizations) is necessarily broad: "Standardization of the terminology, problem description, programming languages, communication characteristics, and physical (non-electrical) characteristics of computers and information processing devices, equipment and systems, and other necessary methods for specification and control."

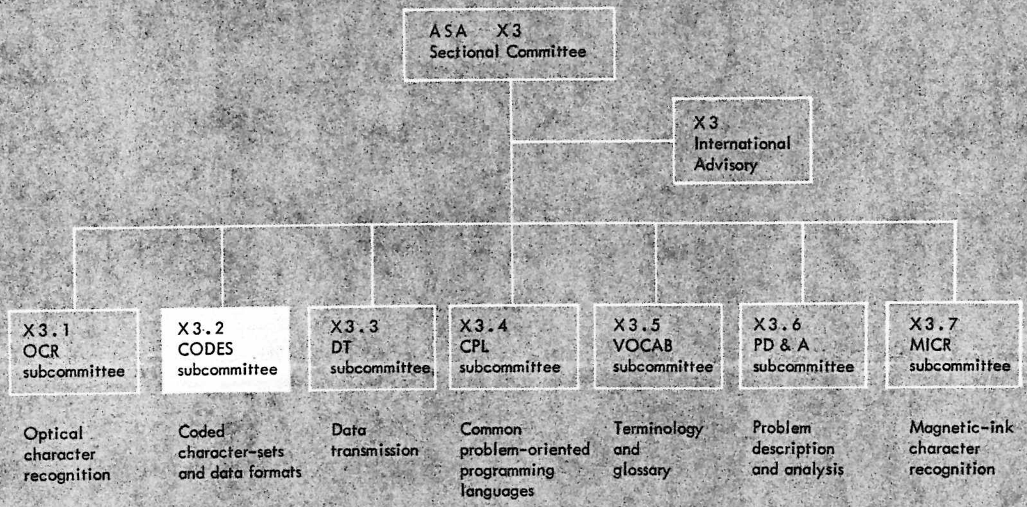
The X3 committee has seven subcommittees responsible for the technical work of providing for the initial standardization requirements of information processing (chart on facing page).

Subcommittees and working groups

Each subcommittee has defined its



THREE OF THE IBM PRODUCTS that can presently implement ASCII are the 1011 paper-tape reader (left), 1012 paper-tape punch (below left), and 870 Document-writing System (below). Code conversion with the new IBM 7740 Communication Control System is indicated by the schematic at the top of page 10.



ASA's X3 sectional committee has seven subcommittees. The X3.2 subcommittee is the one primarily concerned with ASCII.

range of technical responsibilities and activities in the form of work programs approved by the higher committee. In most subcommittees further subdivision into working groups has been necessary for technical specialization. In all subcommittees and working groups, members function as individuals rather than official representatives of organizations, although a reasonable balance of interests is normal and is desired.

ASCII was developed in the *X3.2 Coded Character Sets and Data Formats Subcommittee,* which is now organized with six working groups whose purpose is to complete the implementation of ASCII. Table of organization of the working groups in this subcommittee is shown on page 10.

Working toward consensus

Organized in the autumn of 1960, the X3.2 subcommittee held frequent meet-

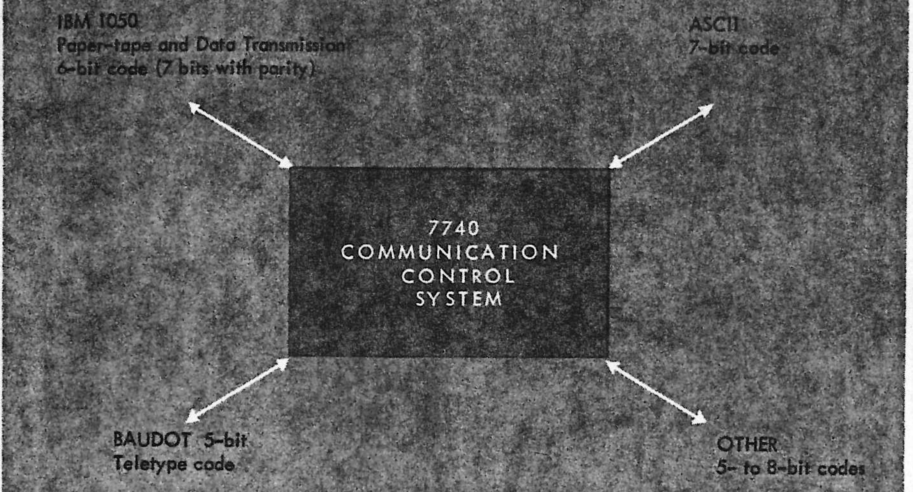
continued on page 10, bottom

USING ASCII *continued from page 8*

To convert these codes to the internal machine code of the associated computer, the 7740 requires a translator program. Whenever data is transmitted to the 7740 in ASCII, the 7740 can use its programmed-translation ability to convert ASCII-coded data directly into the code of the processing system. The 7740 will be able to accept ASCII as implemented in the data-transmission medium.

As soon as the ASCII standards for perforated tape and data transmission are completed, the above features can be adapted to those standards.

IBM plans to provide whatever may be needed to handle ASCII in other input/output media, including punched cards and magnetic tape, at such time as the standards for these have been sufficiently developed.



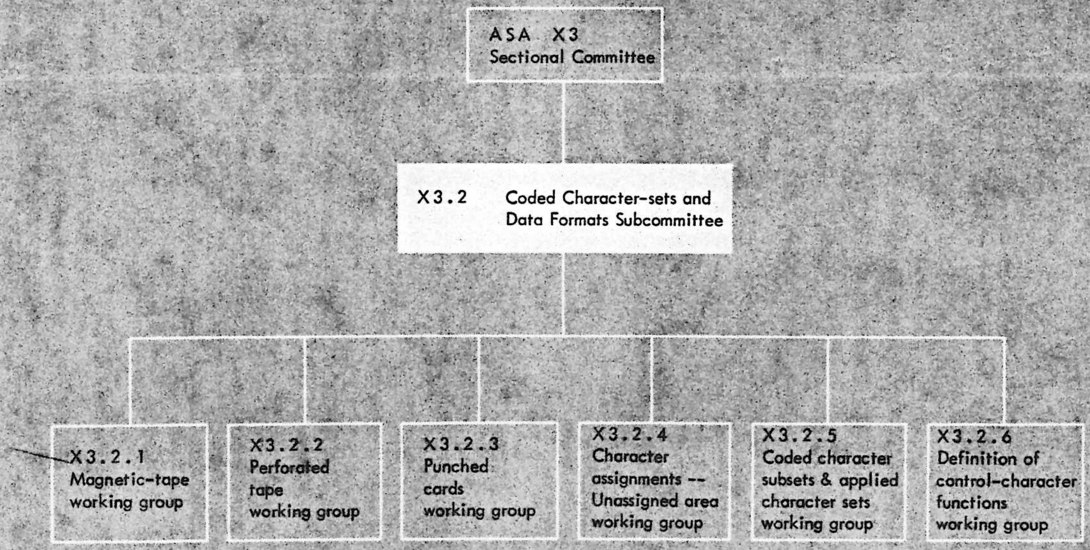
NEW IBM 7740 Communication Control System is designed to perform a wide variety of communication functions, including conversion of information from one code to another. Any 5- to 8-bit code can be translated to any other code.

DEVELOPING *continued from page 9*

ings; by November, 1961, it recommended unanimously (to the X3 committee) that a standard proposal was ready for consideration.

In March, 1962, the sectional committee began balloting to determine its members' opinions on the proposed standard. Some modification was made in the proposal during consideration at this level. In September, 1962, the X4 committee pointed out that the proposal was inappropriate for office machines use. By early December, the balloting was complete and the proposal was approved by the majority of the X3 membership.

At that point ASA was asked to consider whether other "standards" already in use might be considered concurrently with the X3.2 proposal. ASA recom-


ASA X3
Sectional Committee
X3.2 Coded Character-sets and Data Formats Subcommittee
X3.2.1
Magnetic-tape working group
X3.2.2
Perforated tape working group
X3.2.3
Punched cards working group
X3.2.4
Character assignments -- Unassigned area working group
X3.2.5
Coded character subsets & applied character sets working group
X3.2.6
Definition of control-character functions working group

ASA's X3.2 subcommittee has six working groups engaged on ASCII.

Supporting ASCII and Other Data Processing Standards

As a company concerned with service and manufacture, IBM strongly supports the development of data processing standards and regards such development as important to our customers and the industry in general.

We participate in ASA committees developing ASCII and other standards—in data transmission, programming languages (COBOL and FORTRAN), equipment interfaces (connectors), characters and print-quality specifications for optical and magnetic recognition, flow-chart symbols, and many other areas. Representatives of IBM World Trade Corporation participate in comparable standards activities in other countries, and both WTC and domestic personnel are active in the development of international standards.

Because standardization is so important, we have already begun to implement ASCII and will provide additional implementation as media standards progress. Planning and understanding will be key factors in wide acceptance of ASCII and will assure its success as a national standard. Its true potential will be achieved with the specifications for the remaining details.

Despite differences of opinion on whether it is possible to achieve an "ideal" code, the data processing community has succeeded in reaching agreement on a standard code for information interchange. ASCII is a significant accomplishment, it is a new American Standard, and it should be supported and encouraged.

We as a corporation are determined to move ahead with ASCII at the most rapid pace possible so that our customers can gain the benefits of standardization across the industry. This new standard can make intercommunications between all manufacturers' equipment and, ultimately, interchangeability of different manufacturers' equipment, a reality. ■

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mended that every effort be made to avoid conflicting standards. BEMA, which was the ASA-appointed sponsor responsible for administration and direction of the standards project, then made its "sponsor's recommendation." This questioned whether a complete evaluation was possible at that time because the proposed code had not been adapted to each of the media affected. The X3 committee reviewed matters in January, 1963, and re-affirmed its position. Without further delay, the code proposal was transmitted out of committee to the next level of review.

Final step was normal ASA internal reviews to verify that ASCII was acceptable by a consensus of all national groups concerned with its scope and provisions. The code proposal was approved as an American Standard on June 17, 1963.

The job ahead

With a subject as complex and far-reaching as this, of course, much remains to be done. Some indication of this shows on the ASA organization charts. The X3.2 subcommittee's six working groups are still very much in harness. Three media groups—on magnetic tape, perforated tape, and punched cards—are each working toward a pair of similar objectives:

1. Determination of exactly how ASCII is to be placed in each medium.
2. Physical specifications for each medium.

In the area of perforated tape, much progress has already been made, with only a few items to be resolved. Magnetic-tape discussions to date have concentrated primarily on the physical characteristics—such as tape width and recording method.

The punched-card group is looking at two methods for the placement of ASCII in the 80-column card. The first is a direct representation in binary-coded form. The second is a representation in Hollerith-coded form. This latter method would employ the Hollerith coding technique for representing each of the 128 ASCII bit codes.

The remaining three working groups are concerned with questions pertaining to use of the unassigned area of the code (28 positions); method for handling the lower-case alphabet; method of ESCAPE from and to ASCII; and, finally, other control functions and definitions that may be necessary for data transmission.

Statistics can hardly suggest the magnitude of the work already done, being done now, and still to be done. The number of people involved gives only a rough idea: participants now number at least 16 in the X3.2 subcommittee, and range from 7 to 18 individuals in *each* of the six working groups.

Dynamics of the continuing project go beyond immediate tasks of adaptation and implementation. For all practical purposes, a national standard can be regarded as such only if it is widely accepted and used. ■

Composition and membership of the X3 Sectional Committee of the American Standards Association are given on page 12.

ASA

X3 Sectional Committee

MEMBERSHIP

General Interest Group

- American Institute of Electrical Engineers
- Association for Computing Machinery
- Association of Consulting Management Engineers
- American Management Association
- Data Processing Management Association
- Department of Defense
- Electronic Industries Association
- Engineers Joint Council
- Institute of Radio Engineers
- Telephone Group

User Group

- American Bankers Association
- American Gas Association and Edison Electric Institute
- American Petroleum Institute
- Air Transport Association
- General Services Administration
- Insurance Accounting and Statistical Association
- Joint Users Group
- Life Office Management Association
- National Retail Merchants Association

Manufacturer Group*

- Burroughs Corporation
- International Business Machines Corporation
- Minneapolis-Honeywell Regulator Company EDPD
- Monroe Calculating Machine Company
- National Cash Register Company
- Pitney-Bowes, Incorporated
- Radio Corporation of America
- Remington Rand Division of Sperry Rand Corporation
- Royal McBee Corporation
- Standard Register Company

***One association, BEMA (Business Equipment Manufacturers Association), represents manufacturers in X3. The manufacturer group's 10 votes represent BEMA's position and are held by 10 member companies, selected annually from larger membership.**

Published by International Business Machines Corporation. IBM Data Processing Division, 112 East Post Road, White Plains, N. Y. PRINTED IN U.S.A.

Datamation oct 1963 v9 #10

letters

baudot & ascii

Sir:

Since publication of the first part of my article on the ASCII (August, p. 32), I have had a letter from Walter Zenner, vice president for Research and Development at the Teletype Corp. He draws attention to the fact that wear on punch dies was a minor and perhaps non-contributory reason for the design of the Baudot code. He states the real reason was that Baudot did his work about 1875, at which time electric utilities did not exist; in fact, electric light was not invented until about 1879. Baudot's power source was model 1875 batteries, and his need to conserve power was very real, the marking pulses requiring the operation of an electromagnet. The code was therefore based upon the frequency of the letters as found in French text, which differs slightly from English.

I am glad to have this opportunity to indicate more sympathetic treatment of Baudot, as requested by Mr. Zenner. For my own part, I was very much surprised when I was unable to find entries on Baudot in several encyclopedias and in the biographical section of Webster's Unabridged. I would have thought also that Baudot's work was of considerably more importance to human communication than many of the minor writers whose names can be found in these sources.

R. W. Bemer
Univac Div. of Sperry Rand Corp.
New York, New York

voice from europe

Sir:

Much more familiarity with the British, rather than the Continental, scene was demonstrated by A. S. Douglas ("The European Computer Scene: 1963," August, p. 24). The German manufacturers who "have not really got going yet" have installed about 110 computers, or 16 per cent of some 700 delivered systems, according to our April 1963 German Computer Census.

Telefunken's TR 4, "due for delivery shortly," delivered its third in June 1963; the first was installed in 1962. Siemens, who "will come into the field soon," claims it installed the first gp, transistorized computer, the 2002, in late 1958; since then, it has installed some 30 2002's, and has about 10 orders for its 3003, announced this past spring. Bull's "new machine the Gamma 300," is probably the Gamma 10; its 300's were first delivered in the spring of 1961, and the Gamma 60 is not a "vacuum tube machine", but, rather, solid state.

Zuse, which stands second to IBM in number of deliveries in Germany, announced and demonstrated its new Z 25 in May 1963, and has four systems on order to date.

F. J. Lesh
John Diebold & Assoc. Deutschland GMBH
Frankfurt/Main, Germany

Dr. Douglas replies: It is true that my article was based on less recent information than that available to Mr. Lesh, and I am glad to hear of the recent progress made in Germany. Nevertheless, I believe my remark that the German manufacturers "have not really got going yet" is entirely substantiated by the figures above. I am sure that they have the technical capacity to fill a much larger share of the market there, and will, no doubt, do so over the next few years. The Bull Gamma 300 should indeed be the Gamma 10, a slip for which I apologize.

need for warm bodies

Sir:

As long as I have been programming, I have heard about this "extreme shortage of programmers" (see January Editor's Readout). But what is being done about it?

My husband has received a high B on the IBM aptitude test, has completed some home study manuals, written small programs, and read of data flow and other deeper texts. His problem is this: no one wants trainees. I realize there are many people in the same predicament. How does a person in this situation get into programming and/or how does he get past the screening question on personnel forms, "How much experience?" I don't think most dp departments are aware of the amount of good people turned away as a result of poor communications.

Peggy Randall
Redwood City, California

rca & base numbers

Sir:

At first glance, I was inclined to agree with your tongue-in-cheek query (August, p. 19) about whether the name of the RCA 3301 might have been chosen to suggest that the new machine was "three times as fast as the 301." But then I overheard myself sub-vocalizing. Surely, the *Thirty-three*-Oh-One ought to be 11 times as fast as the *Three*-Oh-One. Even if we divide, we get 3301/301=10.967, which is equivalent to 11 for many practical purposes . . .

These figures assume, of course, that RCA is using the decimal system. Since we have no proof of this, perhaps we should give them the benefit of the doubt and consider whether they might be making a more modest suggestion in another number system. The existence of the RCA 601 implies that they are using at least a septimal system; and since $33_{(7)}=24_{(10)}$, they might be hinting at only an eight-fold increase. For the octal or novenary systems, the hints would be of only nine- or 10-fold increases. Of course, if they are using a base greater than 10, the sky's the limit.

Ronald E. Wyllys
Chatsworth, California

red punch tape

Sir:

Comrade Gukov (August, p. 29) seems to think that the glorious promise of the proletarian October revolution is at long last on the threshold of realization, now that the decadent capitalists have invented computing machinery. The era of total centralized planning (and total regimentation) apparently will be ushered in just as soon as the Marxists can get their hands on a few megabucks' worth of degenerate imperialist engineering know-how and/or hardware.

The collectivists sound quite confident that they will then be able to deal effectively with all of those cosmopolitan saboteurs and enemies of the working class who persist in inventing color television, rotary lawn mowers, zippers, and other bourgeois gadgets that are not listed in the Kremlin master diskfile which controls the "clockwork economy" (as Academician Glushkov so colorfully terms it).

The chief remaining task will then be to develop a machine to read weather reports and, using a modified PERT analysis, punch out a master plan for manufacturing the bullets that will be needed for educating the luckless Ivans whose cabbage crop doesn't quite meet the planners' cybernetically-generated quota.

Paul Stout
Lombard, Illinois

DEPARTMENT OF DEFENSE
UNITED STATES OF AMERICA

DEPARTMENT OF THE NAVY
NAVY MANAGEMENT OFFICE
WASHINGTON 25, D. C.

29 November 1963

MEMORANDUM TO MEMBERS, ALTERNATES, AND CONSULTANTS OF A.S.A. X3.2 AND TASK GROUPS

Subj: Report of ISO/TC-97/SC 2 meeting of Oct 29-31, 1963

An unofficial report of the Paris meeting of ISO/TC-97/SC 2 is attached. Mr. Sluis provided the unofficial translation of the Working Group B session. We should eventually receive the official Secretariat's report of the meeting.

Establishing a U.S.A. position on the various items acted on or proposed at the SC 2 meeting and the preparation of proposals on media imposes a very heavy work program on X3.2 and Task Group members. Much of this work must be completed during December 1963, in order that the necessary clearance for international submission may be obtained from X3 early enough for international distribution and discussion at the May 1964 meeting of ISO/TC-97/SC 2.

This work program was discussed at the November 1963, X3.2 and Task Group meetings and action was taken on a number of the items.

L. L. GRIFFIN
Chairman X3.2

cc:
Chairman X3 (2 copies)

NMAH
3/6/4

UNOFFICIAL

Report of ISO/TC 97/SC 2 - Meeting of October 29-31, 1963

Enclosures

1. Delegation Lists - SC 2, WG A & B.
2. Resolutions acted upon by SC 2, with code table (unofficial version).
3. Report of Group B - Numerical Control of Machine Tools - UNOFFICIAL TRANSLATION OF CHAIRMAN'S REPORT provided by delegate M. H. Sluis.

Papers distributed by U. S. Delegation

a. Document No. ISO/TC 97/SC 2 (USA12)67; CONTROL CHARACTER DEFINITIONS by TGX3.2.4 dated 26 Sept. 1963 with CODE EXTENSION (Shift and Escape) working paper of 25 Sept 1963 attached.

b. Document No. ISO/TC 97/SC2 (USA 13) 68 - U. S. Activity Report on Punched Tape dated Oct. 11, 1963.

c. Document No. ISO/TC 97/SC 2 (USA 14) 69 - Activity Report of Work Underway in X3.2.1 dated 4 October 1963.

d. Document No. ISO/TC 97/SC 2 (USA 15) 70 - Activity Report of X3.2.3 dated Oct. 10, 1963.

Proposals distributed by other Nations.

a. Document No. ISO/TC 97/SC2 (Italy I) 58E - ITALIAN PROPOSALS FOR THE USE OF 6th AND 7th COLUMNS OF THE 7-BIT CODE - dated Oct. 1963.

b. Document No. ISO/TC 97/SC2 (France-2)55E - FRENCH PROPOSALS IN VIEW OF ALLOWING THE INSERTION OF LOWER CASE ALPHABET AND ACCENTUATED LOWER CASE LETTERS IN ISO DRAFT-PROPOSAL 7 BIT CHARACTER CODE - Oct. 1963.

Documents of interest Distributed.

a. Document No. ISO/TC 97/SC2 (ECMA-2)51E ECMA PHILOSOPHY ON CODES, March 1963.

b. Document No. ISO/TC 97/SC2 (Germany 3) 59 - German Considerations o
Representation of 6-Bit Code in Punched Cards (Undated).

c. Document No. ISO/TC 97/SC2 (Japan I) 56E - OPINIONS OF THE JAPANES
MEMBER COMMITTEE ON THE ISO DRAFT CODE FOR INFORMATION INTERCHANGE dated Oct. 1963.

The meeting was held in the new U.I.C. building near the Eiffel Tower. Mr. Frontard, Manager of AFNOR, opened the meeting and Mr. Feissel was re-elected Chairman. An editing committee consisting of Mr. G. Chadwick, Mr. L. Durand and Mr. C. E. Mackenzie was appointed.

During the discussion of the agenda, the United States recommended that the responsibilities of SC-2 in the Numerical Control of Machine Tool area be limited to character sets and code representation in media. This recommendation was not supported by a majority of the delegates.

At the request of the United States, an activity report of International Organizations was added to the agenda. The Draft Report of the WGB meeting 8-9 October 1962 was approved. Mr. Besseyre reported on the activity of CCITT with respect to a new "alphabet" and called attention to the report document ISO/TC 97/SC2 (CCITT-1) 44 of July, 1963.

Mr. Cluff, representing ECMA stated that an ECMA standard on a 6 bit code had been issued and that work was underway on a 7 bit code as well as media implementation of the two codes in perforated tape and magnetic tape.

Mr. Chadwick requested that each national delegation be given an opportunity to report on national activity.

The representative of Japan reported that there are about 800 computers in Japan, that Japan intends to adopt the 7-bit code, one code only. Japan has a requirement for more than the 26 alphabet characters provided in the 7 bit set.

The representative of France reported that work has been underway on assignments for the "UNASSIGNED" section of the 7 bit code.

The Italian representative reported that Italy had prepared a proposal for working Group A on assignments for the "UNASSIGNED" section.

Representatives were appointed to Working Groups A and B as shown on attached membership lists. Mr. Ross was named chairman of WGA and Mr. Chalancon of WGB.

WORKING GROUP A

Working Group A convened at 3:00 p.m. October 29, added code representation in media to the agenda and proceeded to review the comments on the 6 and 7 BIT CODE Proposal.

A. CODE STRUCTURE

The chairman concluded that no country had seriously questioned the structure of the 6 and 7 bit coded character sets and that WGA should proceed to the consideration of specific points.

B. CONVERSION BETWEEN 6 AND 7 BIT CODE

After discussion of conversion between the 6 and 7 bit codes, it was concluded that little could be done to simplify translation without sacrificing other features of the code sets.

C. FIVE BIT SET

The delegate from Sweden made a strong plea for a "5 bit set" consisting of 4 information bits plus parity and suggested shifting a number of characters from the special character column into the column of digits in the code table. After some discussion the chairman expressed the consensus that the suggestion had been carefully considered and other desirable features such as collating order had been given greater weight in designing the code. The chair ruled that national and industry groups should study and submit recommendations to SC 2.

D. LOWER CASE ALPHABET

On allocation of the UNASSIGNED columns of the code table, a majority of the delegations were in favor of allocating a lower case alphabet in the relative positions opposite the capital letters. Two votes were taken as follows:

a. Placement of small letters without qualifying notes. (The vote was as follows: Yes - Netherlands, Germany, United Kingdom, Italy, Switzerland; No - None; Abstain - France, Japan, United States).

b. With qualifying notes such as specifying alternate use. (The vote was as follows: Yes - France; No - United States, Italy, United Kingdom, Netherlands, Switzerland; Abstain - Germany, Japan).

E. ALTERNATE USE CHARACTERS

The three code positions immediately higher than the two alphabets in the 7-bit code table as well as the currency symbol code position should be reserved for national usage in the opinion of the majority of delegations.

F. BACKSPACE

Agreement was reached that the function "backspace" should be assigned in the code position designated FE_0 in the 7-bit code table. (This function to be used to operate carriage, not tape.)

G. DIACRITICALS

In a number of European countries, the use of a lower case alphabet is tied to the availability of diacritical marks for accenting letters. Apparently many of delegations favor including diacriticals in the code table but disagree on whether four or five are needed. The proposal to be circulated will show (see code table) the "double quote" and "apostrophe" slightly modified in shape to do dual duty as diacriticals and the "up arrow" and "left arrow" replaced by "diacriticals". In addition, a choice is to be indicated between a fifth diacritical and the "number" symbol. The chairman "Mr. Ross" made a statement to the effect that the question as to which symbols are least important should be examined so that nations which require accenting by use of diacritical can substitute when required. The concept of substituting when required, was challenged by Italy and seems in conflict with CCITT concept of international use of separate letters and accents in Telecommunication operations. (The operational Telecommunications use proposed at SC-2 was as follows: (1) Transmit letter, (2) Transmit Backspace (3) Transmit appropriate diacritical symbol for overprinting. The use to be made of accented letters in information processing was not clear but opinions were expressed that they would not be manipulated as three character combinations).

Italy will submit a proposal making a case for "Physical End of Medium" in lieu of "logical End of Medium" (LEM) in the code table.

H. REASSIGN "ACKNOWLEDGE", GRAPHIC REPRESENTATION OF

Reserving the three code positions higher than lower case z in the code table for national use necessitated consideration of a new location for the ACK (acknowledge) character presently shown in one of these positions. Italy proposed that it be relocated in the position lower in the code table than lower case a; and that its graphic representation be "under line". Discussion of assignment of "under line" was terminated by the Chair as being a new proposal not in accord by the SC-2 chairmans rule that discussion be limited to proposals previously submitted. The discussion indicated that most of the

delegations looked on the function of "acknowledge" as a response that a station has been connected, not as an automatic error control function acknowledging correct receipt of information. The Chair ruled that discussion of error control was out of order, it not having been raised in any proposals or comments submitted.

I. MEDIA IMPLEMENTATION (Perforated Tape)

Following formation of two subgroups to discuss explanatory notes (definitions) and diacriticals, the remainder of Working Group A discussed implementation of the code on perforated tape. Agreement was reached that the tracks on 1 inch perforated tape should be numbered 1 through 8. There was no indication that this agreement included other than 1 inch 8 track tape. The placement of the "check bit" was discussed as well as order of bit transmission, both briefly in limited time available. The CCITT representative indicated his organization preferred "odd parity" on transmission systems. On order of bit transmission he stated in effect that traditionally CCITT has used low order to high order and that very strong arguements in favor of high order to low order would have to be presented for CCITT to give way.

A U. S. inquiry as to whether all agreed that the "check bit" should be transmitted last was not supported. Time had run out, however, and failure to support may not represent opposition.

The Chairman of WGA instructed the delegations to be prepared to discuss the following points at the May 1964 meeting of SC2:

1. Check bit position in perforated and magnetic tape.
2. Parity of check bit in perforated and magnetic tape.
3. Code bit positions in tape.
4. Relationships for order of transmission sequence.
5. Sequence of transmission.
6. Sense of check bit in data transmission.
7. Relation between significance of bits and transmission sequence.
8. Inter-relationships of above items on the various media.
9. Keyboard arrangements.

J. EXPLANATORY NOTES

In the brief time available the group working on explanatory notes to the code table agreed on changes to a number of definitions. Neither these changes nor the explanatory notes in general were discussed by Working Group A or the plenary session of SC-2.

K. CODE TABLE

The sub group on "Diacriticals" prepared the revised code table attached to the unofficial copy of the Resolutions.

WORKING GROUP B

The attached report prepared by Mr. M. H. Sluis outlines the activity of this group.

RECONVENED PLENARY
SESSION SC-2

Subcommittee 2 reconvened in plenary session to receive reports of the Working Group Chairmen and to act on the resolutions prepared by the editing committee.

A. RESOLUTION 1

After discussion in which the U.S.A. and Germany took exception to several points enumerated in Resolution 1 as having been agreed to, some revisions were made to make the points subject to comment.

B. RESOLUTION 2

The CCITT was requested to study the 7 bit code with respect to their need for an "Alpha" and a "Beta" control character and advise SC-2. "Alpha" and "Beta" had previously been defined respectively as "synchronous line idle" and "customer idle". CCITT is expected to determine whether characters already in the code table will suffice or whether additional codes should be assigned for "alpha" and "beta" functions. There seemed to be disagreement among the delegates as to what the specific functions of "alpha" and "beta" actually are.

C. RESOLUTION 3

The establishment of a permanent Working Group on Numerical Control of Machine Tools under Subcommittee 2 was approved.

D. RESOLUTION 4

Accepted without change.

E. RESOLUTION 5

The draft of this resolution was revised to leave the door open for media other than perforated tape to be considered with 8 track perforated tape to be considered first.

NEXT MEETING

The next meeting of ISO/TC 97/SC-2 and WG-B was tentatively set for New York City as follows:

SC-2 -- May 12-13-14-15, 1964

WG-B -- May 11 and 13, 1964 with the WG-B members attending SC-2 in joint session May 12, 1964.

The SC-2 Secretarial (France) will attempt to have a revised proposal reflecting the above results available to TC 97 Secretariat (USA) for circulation to the participating countries and interested organization by December 15, 1963 with comments to be returned to SC-2 by March 15, 1964.

The objective is to have a draft Recommendation ready for ISO/TC 97 consideration at the May 1964 meeting in New York City.

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ISO/TC-97/SC2 7 Bit Code Table to be circulated for comment
Developed October 31, 1963

~ proposed
# second

7 BIT SET TABLE

TABLEAU DE CODE A 7 ELEMENTS D'INFORMATION

b7				0	0	0	0	1	1	1	1
b6				0	0	1	1	0	0	1	1
b5				0	1	0	1	0	1	0	1
b4	b3	b2	b1								
0	0	0	0	TC0 (Null)	DC0 (DLE)	Space	0	④ (@)	P	_ ⑦	p
0	0	0	1	TC1 (SOH)	DC1	!	1	A	Q	a	q
0	0	1	0	TC2 (EOA)	DC2	"	2	B	R	b	r
0	0	1	1	TC3 (EOM)	DC3	~ / #	3	C	S	c	s
0	1	0	0	TC4 (EOT)	DC4 (Stop)	C$ ⑥	4	D	T	d	t
0	1	0	1	TC5 (WRU)	Error	%	5	E	U	e	u
0	1	1	0	TC6 (RU)	Sync.	&	6	F	V	f	v
0	1	1	1	TC7 (Bell)	LEM	'	7	G	W	g	w
1	0	0	0	FE0 (BS)	IS0	(	8	H	X	h	x
1	0	0	1	FE1 (HT)	IS1	)	9	I	Y	i	y
1	0	1	0	FE2 (LF) ①	IS2	*	: ②	J	Z	j	z
1	0	1	1	FE3 (VT)	IS3	+	; ②	K	④ ([)	k	④
1	1	0	0	FE4 (FF)	IS4	,	<	L	④⑤ (\)	l	④
1	1	0	1	FE5 (CR) ①	IS5	-	=	M	④ (])	m	④
1	1	1	0	SO	IS6	.	>	N	^	n	Escape
1	1	1	1	SI	IS7	/	?	O	`	o	Delete

Reference :
DATE :

Note ① should be modified according to decisions taken

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...N.95-80

I S O
ORGANISATION INTERNATIONALE DE NORMALISATION
INTERNATIONAL ORGANIZATION FOR STANDARDIZATION

ISO/TC 97/SC 2
JEUX DE CARACTERES ET CODAGE
Secrétariat :
FRANCE

ISO/TC 97/SC 2 - 57
(PARIS - UIC 1)
Octobre 1963

LISTE DE PRESENCE*

29 octobre matin

Président : M. FEISSEL (France)

ALLEMAGNE

MM. LOCKEMANN	Siemens & Halske Munich
NOLLE	IBM Deutschland, Boeblingen
WALTER	IBM Deutschland, Boeblingen

ETATS-UNIS

MM. GRIFFIN	Navy Management Office U.S. Navy Department
BOOTH	Teletype Corporation
GREY	Secrétariat ISO/TC 97
GRYB	American Telephone & Telegraph Co.
LITTLE	National Bureau of Standards
C.E. MACKENZIE	IBM Corporation
W.H. McKENZIE	ITT - Data and Information Systems Division
SLUIS	Pratt & Whitney Company

FRANCE

MM. FRONTARD	Directeur à l'AFNOR
CHALANÇON	Sté Alsthom
DURAND	Cie machines Bull
GUILHAUMOU	IBM France
LOGEZ	E.D.F.
PROFIT	C.N.E.T.
THIARD	C.N.A.
WEILL	Cie machines Bull

.../...

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Arc. : 6 791 E

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* On a souligné le nom du chef de délégation.

ation Française
alisation (AFNOR)
rue N.D.-des Victoires
IS 2°
l. : CEN. 95-80
ORG
INTE

ITALIE		
	MM. GOTTLIEB	Laboratorio Ricerche Elettroniche Pregnana Milanese
	POMELLA	C.Olivetti & C.
JAPON		
	M. YAMASHITA	Université de Tokio
PAYS-BAS		
	M. VAN DUUREN	Dr. Neher Laboratorium PTT
ROYAUME-UNI		
	MM. G. CHADWICK	BSI
	W. EADIE	IBM - Europe
	F.G. HELPS	Industrial Division, E.M.I.
	J.P. POW	Systems Standards, NCR, Ltd.
	H.M. ROSS	Ferranti Computer Engineer
	J.R.W. SMITH	B.T.R.
	B.E. SUMMERTON	IBM - World Trade Laboratories
SUEDE		
	M. M.G. SUNDBLAD	Svenska Dataregister AB - Elektronikandelningen
SUISSE		
	M. Dr. W. KAESLIN	IBM - Zürich

ORGANISATIONS INTERNATIONALES

CCITT	MM. J. BESSEYRE	Département télégraphie & transmissions de données du CCITT
	D. FAUGERAS	Groupe de travail "Alphabets" du CCITT
ECMA	M.E.G. CLUFF	I.C.T. Ltd
UIC	MM. MENSO	Secrétariat Général UIC
	MOELIBECQ	Sous-commission des équipements électroniques pour le traitement des données - Bruxelles
	TOUGNE	Sous-commission du traitement mécanographique de l'Information
UPU	M. BRUNIER-COULIN	Direction générale des postes

Secrétariat ISO/TC 97/SC 2 : Mlle LIMA (AFNOR)

Interprète : Mlle CHAUMONT

Resolutions acted upon at ISO/TC 97/SC 2 Meeting
October 29-31 1963
(Unofficial preliminary version)

L. L. Griffin
Nov. 2, 1963

Resolution 1

The draft proposal for standard character codes (document ISO/TC 97/SC 2 (Sec. 12)30) having been voted upon, and the comments in document ISO/TC 97/SC 2 (Sec. 14)37 having been reviewed, it is agreed to accept these codes subject to further review.

A revised document is to be prepared as a Draft ISO Proposal. The SC2 Secretariat is asked to prepare this, based on Document ISO/TC 97/SC2 (Sec. 12)30, embodying the decisions taken during the meeting of the Working Group, arising from comments received.

The TC 97 Secretariat is asked to submit this revised document to P and O members of TC 97 and interested international organizations asking for comments in time for the proposed TC 97 meeting in the Spring 1964.

In preparing the revised document, the following points should be included:

1. To allocate the small letters to columns 6 and 7 of the 7-bit code table.
2. Provision for diacritical signs.
3. Allocation of positions reserved for National Usage.
4. Specific coding for Backspace.
5. Recoding of the position in the code table reserved for possible use for Acknowledge. Printing symbol for it.
6. Numbering of rows and columns of code tables.
7. Revised wording for certain of the Notes and the Explanatory Comments.

Concerning the realization of the codes in punched tapes, it was agreed to number the tracks on tape as 1, 2, 3, Feed hole, 4, 5 and for wider tapes 6, 7 and 8.

Resolution 2

ISO/ TC 97/SC 2 requests the CCITT to study the 7-bit draft ISO code proposal in particular with respect to the alpha and beta characters that may be required in certain telecommunications systems and to advise ISO/ TC 97/SC2 of the results.

Resolution 3

A Working Group of ISO/ TC 97/SC 2, should be set up to examine the problems of the Numerical Control of Machine Tools. The Working Group should be empowered to liaise with all ISO/ and IEC Committees which are concerned with any aspect of this subject.

Resolution 4

Pending the agreement of ISO/ TC 97, the AD HOC Working Group B for Numerical Control of Machine Tools should study in detail the proposals made by the secretariat in Doc. ISO/ TC 97/SC2 (Sec. 15) 38.

Specifically the following points should be examined:

a) Tape coding
b) Glossary, initially limited to tape coding for machine tools
c) Block format
d) Sequence of information within the block
e) Error checking
f) To advise ISO/ TC 95/SC 8 on the special requirements for punched tape employed in workshops.

Resolution 5

It is recommended that the 7-bit character code in ISO/ TC 97/SC 2 (Sec. 12) 30 as amended, should be considered for application to the Numerical Control of Machine Tools, and first with respect to punched tape on 8 tract tape.

FILE

Resolutions acted upon at ISO/TC 97/SC2 Meeting
October [illegible]-31 1963
(Unofficial preliminary version)

L. L. Griffin
Nov 2. 1963

Resolution 1

The draft proposal for standard character codes (document ISO/TC 97/SC 2 (Sec. 12)30) having been voted upon, and the comments in document ISO/TC 97/SC 2 (Sec.14)37 having been reviewed, it is agreed to accept these codes subject to further review.

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NMAH 310/4

FILE

Resolutions adopted by the ISO/TC 97/SC 2 meeting
October [illegible] 1963
(Unofficial preliminary version)

L. L. [illegible]
[illegible]

Resolution 1

The draft proposal for standard character codes (Doc. ISO/TC 97/SC 2 (Sec. 12) 30) having been voted upon, and the comments in document ISO/TC 97/SC 2 (Sec. 14) 37 having been reviewed, it is decided to accept these codes subject to further review.

A revised document is to be prepared as a Draft ISO Proposal. The SC 2 Secretariat is asked to prepare this, based on document ISO/TC 97/SC 2 (Sec. 12) 30, embodying the decisions taken during the meeting of the Working Group, arising from comments received.

The TC 97 Secretariat is asked to submit this revised document to members of TC 97 and interested international organizations for comments in time for the proposed TC 97 meeting in the Spring [illegible].

In preparing the revised document, the following points should be included:

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DEPARTMENT OF DEFENSE
UNITED STATES OF AMERICA

DEPARTMENT OF THE NAVY
NAVY MANAGEMENT OFFICE
WASHINGTON 25, D. C.

29 November 1963

MEMORANDUM TO MEMBERS, ALTERNATES, AND CONSULTANTS OF A.S.A. X3.2 AND TASK GROUPS

Subj: Report of ISO/TC-97/SC 2 meeting of Oct 29-31, 1963

An unofficial report of the Paris meeting of ISO/TC-97/SC 2 is attached. Mr. Sluis provided the unofficial translation of the Working Group B session. We should eventually receive the official Secretariat's report of the meeting.

Establishing a U.S.A. position on the various items acted on or proposed at the SC 2 meeting and the preparation of proposals on media imposes a very heavy work program on X3.2 and Task Group members. Much of this work must be completed during December 1963, in order that the necessary clearance for international submission may be obtained from X3 early enough for international distribution and discussion at the May 1964 meeting of ISO/TC-97/SC 2.

This work program was discussed at the November 1963, X3.2 and Task Group meetings and action was taken on a number of the items.

L. L. GRIFFIN
Chairman X3.2

cc:
Chairman X3 (2 copies)

NMAH 310/4

UNOFFICIAL

Report of ISO/TC 97/SC 2 - Meeting of October 29-31, 1963

Enclosures

1. Delegation Lists - SC 2, WG A & B.
2. Resolutions acted upon by SC 2, with code table (unofficial version).
3. Report of Group B - Numerical Control of Machine Tools - UNOFFICIAL TRANSLATION OF CHAIRMAN'S REPORT provided by delegate M. H. Sluis.

Papers distributed by U. S. Delegation

a. Document No. ISO/TC 97/SC 2 (USA12)67; CONTROL CHARACTER DEFINITIONS by TGX3.2.4 dated 26 Sept. 1963 with CODE EXTENSION (Shift and Escape) working paper of 25 Sept 1963 attached.

b. Document No. ISO/TC 97/SC2 (USA 13) 68 - U. S. Activity Report on Punched Tape dated Oct. 11, 1963.

c. Document No. ISO/TC 97/SC 2 (USA 14) 69 - Activity Report of Work Underway in X3.2.1 dated 4 October 1963.

d. Document No. ISO/TC 97/SC 2 (USA 15) 70 - Activity Report of X3.2.3 dated Oct. 10, 1963.

Proposals distributed by other Nations.

a. Document No. ISO/TC 97/SC2 (Italy I) 58E - ITALIAN PROPOSALS FOR THE USE OF 6th AND 7th COLUMNS OF THE 7-BIT CODE - dated Oct. 1963.

b. Document No. ISO/TC 97/SC2 (France-2)55E - FRENCH PROPOSALS IN VIEW OF ALLOWING THE INSERTION OF LOWER CASE ALPHABET AND ACCENTUATED LOWER CASE LETTERS IN ISO DRAFT-PROPOSAL 7 BIT CHARACTER CODE - Oct. 1963.

Documents of interest Distributed.

a. Document No. ISO/TC 97/SC2 (ECMA-2)51E ECMA PHILOSOPHY ON CODES, March 1963.

b. Document No. ISO/TC 97/SC2 (Germany 3) 59 - German Considerations on Representation of 6-Bit Code in Punched Cards (Undated).

c. Document No. ISO/TC 97/SC2 (Japan I) 56E - OPINIONS OF THE JAPANESE MEMBER COMMITTEE ON THE ISO DRAFT CODE FOR INFORMATION INTERCHANGE dated Oct. 1963.

The meeting was held in the new U.I.C. building near the Eiffel Tower. Mr. Frontard, Manager of AFNOR, opened the meeting and Mr. Feissel was re-elected Chairman. An editing committee consisting of Mr. G. Chadwick, Mr. L. Durand and Mr. C. E. Mackenzie was appointed.

During the discussion of the agenda, the United States recommended that the responsibilities of SC-2 in the Numerical Control of Machine Tool area be limited to character sets and code representation in media. This recommendation was not supported by a majority of the delegates.

At the request of the United States, an activity report of International Organizations was added to the agenda. The Draft Report of the WGB meeting 8-9 October 1962 was approved. Mr. Besseyre reported on the activity of CCITT with respect to a new "alphabet" and called attention to the report document ISO/TC 97/SC2 (CCITT-1) 44 of July, 1963.

Mr. Cluff, representing ECMA stated that an ECMA standard on a 6 bit code had been issued and that work was underway on a 7 bit code as well as media implementation of the two codes in perforated tape and magnetic tape.

Mr. Chadwick requested that each national delegation be given an opportunity to report on national activity.

The representative of Japan reported that there are about 800 computers in Japan, that Japan intends to adopt the 7-bit code, one code only. Japan has a requirement for more than the 26 alphabet characters provided in the 7 bit set.

The representative of France reported that work has been underway on assignments for the "UNASSIGNED" section of the 7 bit code.

The Italian representative reported that Italy had prepared a proposal for working Group A on assignments for the "UNASSIGNED" section.

Representatives were appointed to Working Groups A and B as shown on attached membership lists. Mr. Ross was named chairman of WGA and Mr. Chalancon of WGB.

WORKING GROUP A

Working Group A convened at 3:00 p.m. October 29, added code representation in media to the agenda and proceeded to review the comments on the 6 and 7 BIT CODE Proposal.

A. CODE STRUCTURE

The chairman concluded that no country had seriously questioned the structure of the 6 and 7 bit coded character sets and that WGA should proceed to the consideration of specific points.

B. CONVERSION BETWEEN 6 AND 7 BIT CODE

After discussion of conversion between the 6 and 7 bit codes, it was concluded that little could be done to simplify translation without sacrificing other features of the code sets.

C. FIVE BIT SET

The delegate from Sweden made a strong plea for a "5 bit set" consisting of 4 information bits plus parity and suggested shifting a number of characters from the special character column into the column of digits in the code table. After some discussion the chairman expressed the consensus that the suggestion had been carefully considered and other desirable features such as collating order had been given greater weight in designing the code. The chair ruled that national and industry groups should study and submit recommendations to SC 2.

D. LOWER CASE ALPHABET

On allocation of the UNASSIGNED columns of the code table, a majority of the delegations were in favor of allocating a lower case alphabet in the relative positions opposite the capital letters. Two votes were taken as follows:

a. Placement of small letters without qualifying notes. (The vote was as follows: Yes - Netherlands, Germany, United Kingdom, Italy, Switzerland; No - None; Abstain - France, Japan, United States).

b. With qualifying notes such as specifying alternate use. (The vote was as follows: Yes - France; No - United States, Italy, United Kingdom, Netherlands, Switzerland; Abstain - Germany, Japan).

E. ALTERNATE USE CHARACTERS

The three code positions immediately higher than the two alphabets in the 7-bit code table as well as the currency symbol code position should be reserved for national usage in the opinion of the majority of delegations.

F. BACKSPACE

Agreement was reached that the function "backspace" should be assigned in the code position designated FE$_0$ in the 7-bit code table. (This function to be used to operate carriage, not tape.)

G. DIACRITICALS

In a number of European countries, the use of a lower case alphabet is tied to the availability of diacritical marks for accenting letters. Apparently many of delegations favor including diacriticals in the code table but disagree on whether four or five are needed. The proposal to be circulated will show (see code table) the "double quote" and "apostrophe" slightly modified in shape to do dual duty as diacriticals and the "up arrow" and "left arrow" replaced by "diacriticals". In addition, a choice is to be indicated between a fifth diacritical and the "number" symbol. The chairman "Mr. Ross" made a statement to the effect that the question as to which symbols are least important should be examined so that nations which require accenting by use of diacritical can substitute when required. The concept of substituting when required, was challenged by Italy and seems in conflict with CCITT concept of international use of separate letters and accents in Telecommunication operations. (The operational Telecommunications use proposed at SC-2 was as follows: (1) Transmit letter, (2) Transmit Backspace (3) Transmit appropriate diacritical symbol for overprinting. The use to be made of accented letters in information processing was not clear but opinions were expressed that they would not be manipulated as three character combinations).

Italy will submit a proposal making a case for "Physical End of Medium" in lieu of "logical End of Medium" (LEM) in the code table.

H. REASSIGN "ACKNOWLEDGE", GRAPHIC REPRESENTATION OF

Reserving the three code positions higher than lower case z in the code table for national use necessitated consideration of a new location for the ACK (acknowledge) character presently shown in one of these positions. Italy proposed that it be relocated in the position lower in the code table than lower case a; and that its graphic representation be "under line". Discussion of assignment of "under line" was terminated by the Chair as being a new proposal not in accord by the SC-2 chairmans rule that discussion be limited to proposals previously submitted. The discussion indicated that most of the delegations looked on the function of "acknowledge" as a response that a station has been connected, not as an automatic error control function acknowledging correct receipt of information. The Chair ruled that discussion of error control was out of order, it not having been raised in any proposals or comments submitted.

I. MEDIA IMPLEMENTATION (Perforated Tape)

Following formation of two subgroups to discuss explanatory notes (definitions) and diacriticals, the remainder of Working Group A discussed implementation of the code on perforated tape. Agreement was reached that the tracks on 1 inch perforated tape should be numbered 1 through 8. There was no indication that this agreement included other than 1 inch 8 track tape. The placement of the "check bit" was discussed as well as order of bit transmission, both briefly in limited time available. The CCITT representative indicated his organization preferred "odd parity" on transmission systems. On order of bit transmission he stated in effect that traditionally CCITT has used low order to high order and that very strong arguements in favor of high order to low order would have to be presented for CCITT to give way.

A U. S. inquiry as to whether all agreed that the "check bit" should be transmitted last was not supported. Time had run out, however, and failure to support may not represent opposition.

The Chairman of WGA instructed the delegations to be prepared to discuss the following points at the May 1964 meeting of SC2:

1. Check bit position in perforated and magnetic tape.
2. Parity of check bit in perforated and magnetic tape.
3. Code bit positions in tape.
4. Relationships for order of transmission sequence.
5. Sequence of transmission.
6. Sense of check bit in data transmission.
7. Relation between significance of bits and transmission sequence.
8. Inter-relationships of above items on the various media.
9. Keyboard arrangements.

J. EXPLANATORY NOTES

In the brief time available the group working on explanatory notes to the code table agreed on changes to a number of definitions. Neither these changes nor the explanatory notes in general were discussed by Working Group A or the plenary session of SC-2.

K. CODE TABLE

The sub group on "Diacriticals" prepared the revised code table attached to the unofficial copy of the Resolutions.

WORKING GROUP B

The attached report prepared by Mr. M. H. Sluis outlines the activity of this group.

RECONVENED PLENARY SESSION SC-2

Subcommittee 2 reconvened in plenary session to receive reports of the Working Group Chairmen and to act on the resolutions prepared by the editing committee.

A. RESOLUTION 1

After discussion in which the U.S.A. and Germany took exception to several points enumerated in Resolution 1 as having been agreed to, some revisions were made to make the points subject to comment.

B. RESOLUTION 2

The CCITT was requested to study the 7 bit code with respect to their need for an "Alpha" and a "Beta" control character and advise SC-2. "Alpha" and "Beta" had previously been defined respectively as "synchronous line idle" and "customer idle". CCITT is expected to determine whether characters already in the code table will suffice or whether additional codes should be assigned for "alpha" and "beta" functions. There seemed to be disagreement among the delegates as to what the specific functions of "alpha" and "beta" actually are.

C. RESOLUTION 3

The establishment of a permanent Working Group on Numerical Control of Machine Tools under Subcommittee 2 was approved.

D. RESOLUTION 4

Accepted without change.

E. RESOLUTION 5

The draft of this resolution was revised to leave the door open for media other than perforated tape to be considered with 8 track perforated tape to be considered first.

NEXT MEETING

The next meeting of ISO/ TC 97/SC-2 and WG-B was tentatively set for New York City as follows:

SC-2 -- May 12-13-14-15, 1964

WG-B -- May 11 and 13, 1964 with the WG-B members attending SC-2 in joint session May 12, 1964.

The SC-2 Secretarial (France) will attempt to have a revised proposal reflecting the above results available to TC 97 Secretariat (USA) for circulation to the participating countries and interested organization by December 15, 1963 with comments to be returned to SC-2 by March 15, 1964.

The objective is to have a draft Recommendation ready for ISO/ TC 97 consideration at the May 1964 meeting in New York City.

Associatior
de Normali
23, rue N
PARIS 2°
Tél. CEN

~ preferred
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ISO/TC-97/SC2 7 Bit Code Table to be
circulated for comment
Developed October 31, 1963

TABLEAU DE CODE A 7 ELEMENTS D'INFORMATION

7 BIT SET TABLE

b4	b3	b2	b1								
			b7	0	0	0	0	1	1	1	1
			b6	0	0	1	1	0	0	1	1
			b5	0	1	0	1	0	1	0	1
0	0	0	0	TC$_0$ (Null)	DC$_0$ (DLE)	Space	0	④ (@)	P	_ ⑦	p
0	0	0	1	TC$_1$ (SOH)	DC$_1$	!	1	A	Q	a	q
0	0	1	0	TC$_2$ (EOA)	DC$_2$	"	2	B	R	b	r
0	0	1	1	TC$_3$ (EOM)	DC$_3$	~ / #	3	C	S	c	s
0	1	0	0	TC$_4$ (EOT)	DC$_4$ (Stop)	cs ⑥	4	D	T	d	t
0	1	0	1	TC$_5$ (WRU)	Error	%	5	E	U	e	u
0	1	1	0	TC$_6$ (RU)	Sync.	&	6	F	V	f	v
0	1	1	1	TC$_7$ (Bell)	LEM	'	7	G	W	g	w
1	0	0	0	FE$_0$ (BS)	IS$_0$	(	8	H	X	h	x
1	0	0	1	FE$_1$ (HT)	IS$_1$	)	9	I	Y	i	y
1	0	1	0	FE$_2$ (LF) ①	IS$_2$	*	: ②	J	Z	j	z
1	0	1	1	FE$_3$ (VT)	IS$_3$	+	; ②	K	④ ([)	k	④
1	1	0	0	FE$_4$ (FF)	IS$_4$	,	<	L	④⑤ (\)	l	④
1	1	0	1	FE$_5$ (CR) ①	IS$_5$	-	=	M	④ (])	m	④
1	1	1	0	SO	IS$_6$	.	>	N	^	n	Escape
1	1	1	1	SI	IS$_7$	/	?	O	`	o	Delete

Reference :

DATE :

Note ① should be modified according to decisions taken

Just as the many human languages make communication difficult between men, many machine languages have created a problem in data communications. A uniform code has now been developed to work between many kinds of data processing systems.

A New Standard Code For Teletypewriters

J. F. Auwaerter

EARLY THIS YEAR a new and unusual teletypewriter was introduced into Bell System service. Instead of the traditional three rows of keys on the keyboard this machine had four rows, making it look quite like a standard office typewriter. Important as this new look will be to the teletypewriter user, its significance could be dwarfed by an underlying but hidden difference which makes this keyboard change possible. The new sets operate on a new seven element code alphabet based upon the American Standard Code for Information Interchange (ASCII) which was approved June 17, 1963, by the American Standards Association.

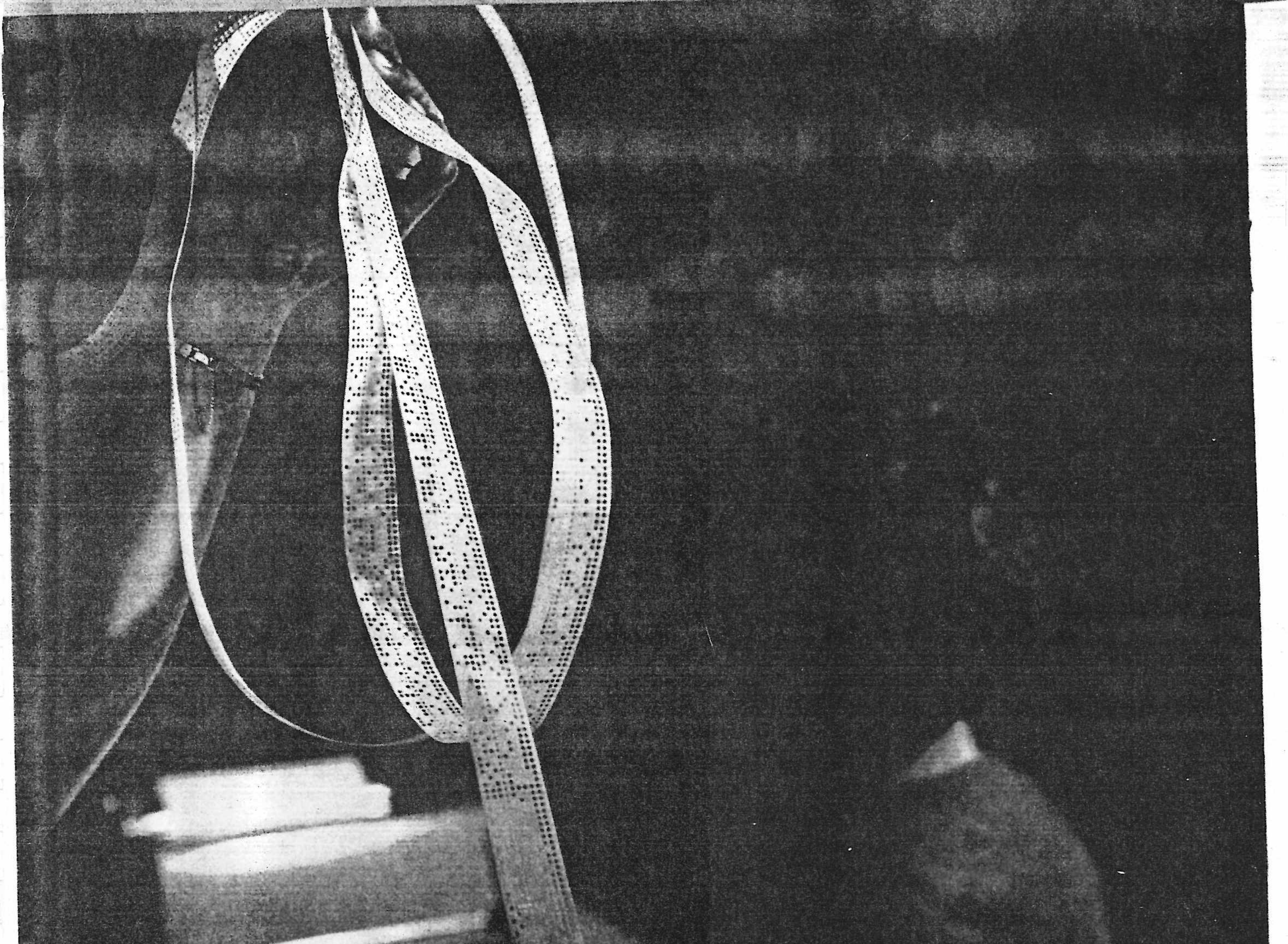
The new code alphabet promises not only to simplify communication by providing the typewriter-like keyboard, but also to benefit the information processing industry by providing a uniform machine alphabet for interchanging data. The code looks to the future, not the past; its structure is based on the binary logic of the modern computer. Because it is thus useful in both digital communications and data manipulation, the code will encourage the interworking of these two fields.

At left is shown the eight-level tape and the new four-row teletypewriter. A drawing of the keyboard showing the placement of all characters is depicted on page 399.

The vast bulk of the communication common carrier's telegraph business has been man-to-man communication, either of messages such as telegrams, or of data such as purchase orders and weather reports. Human operators have "delivered" messages to teletypewriter keyboards, and the telegraphic system has delivered page copy to another human at a distant teletypewriter. In between the information is cast in a five bit code, the so-called "Baudot" alphabet. Since five

vol 41 #10

Bell Laboratories Record



binary digits provide only thirty-two (2^5) permutations, the code's character capacity was doubled by use of a pair of mode shift characters. The alphabet was placed in one case (LETTERS), the numbers and symbols in the other (FIGURES). The limited number of characters in each case made the three row, 32 key, keyboard a natural choice.

But there were difficulties. Typists trained to the four-row standard typewriter keyboard found the three-row teletypewriter keyboard somewhat confusing. Both the quality and quantity of operator output of the mixed alpha-numeric text typical of "data" applications were unsatisfactory on three-row keyboards. On-line, the case shift characters introduced problems of continuing errors where one of two intercommunicating machines failed to receive the proper shift information, and the limited number of special symbols and controls available in the FIGURES case has frequently caused the same code combination to be assigned two or more alternative meanings. This in turn led to difficulties as systems tended to merge. These problems stimulated consideration of a new code both domestically and internationally, but they were not sufficiently serious to warrant a break with the past and all the expenses such a break would entail.

Data Processing

The data processing industry on the other hand was rapidly outgrowing the period where its work was primarily of local concern. In most early applications of data processing, information was converted from documents into machine readable form on the site. There was no problem of connecting machines on a compatible language basis over any significant distance, nor was there much need to interchange data off-line through use of media such as punched tapes, magnetic tapes and punched cards. Under these circumstances equipment manufacturers made independent choices of character sets and code alphabets. Translators took care of boundary conditions.

In recent years a new trend has appeared. Intercommunication between data processors and between processing centers and related equipment is increasing. The Internal Revenue Service will accept income tax forms on magnetic tape—but whose tape and in what code? The Social Security Administration is best served by receiving its data in machine readable form as a by-product of the employer's data processing. Large commercial operations need to transfer data not only within their own operations but also frequently must converse on a machine basis with their suppliers and customers. A standard coded set of characters is the heart of any such interchange of records.

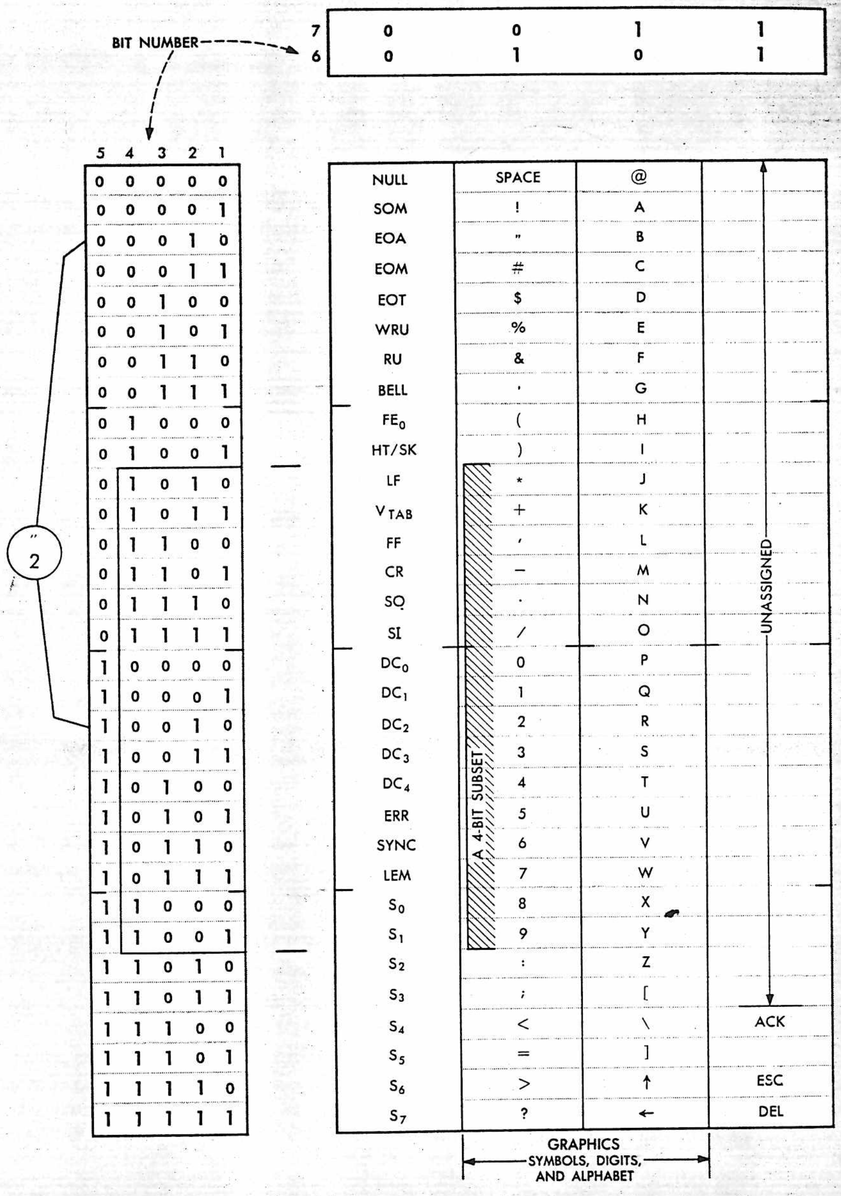
Equipment And Incompatibility

The lack of standards in the data processing industry had another equally restrictive effect on the user of these services. New equipment or replacement equipment was frequently not compatible with his system. Thus he tended to be locked in to his initial system supplier or he would be burdened with the cost of conversion operations when he had to deal with a new supplier whose equipment, although it might be less expensive and more efficient, was incompatible with the original system.

By the end of the 1950s, the data processing industry was very much in need of standardization. Hundreds of different codes were in use. The communication industry, though using essentially only one code, was also beginning to feel the need for better things. It thus became apparent that if a single new code could serve not only the traditional communication market but also the data interchange needs of the information processing market, not only would each class of user benefit in his own area, but also large message communications networks would form an important new facility—a widespread net of compatible and low cost input/output devices for the larger, programmed machines. Further, should such a movement gain international acceptance, the new code alphabet would become a sort of machine Esperanto, reducing the barriers within our multi-lingual human world. It was with this background generally in mind that a group of experts from the data processing and communication industries set to work in 1960 to establish a standard code for information interchange.

Standardization Studies

Working under the guidance of the American Standards Association Sectional Committee X3, this group examined all the codes currently in common use, but none were considered satisfactory. The universally used five-level communications code was obviously unsuited to data manipulation. The most popular code in information processing, the 48 character, 6-bit so-called BCD (binary coded decimal) code, offered the advantage of a simple relationship to the Hollerith punched card code used by tabulating machines, but was not well structured for use in either central processors or other peripheral equipment. The Department of Defense FIELDATA code developed in the mid-



The new ASCII code shown in binary order. The extreme left of the drawing shows the five lower order bits. At top are the two higher order bits. The symbol (") appears on the same key as 2 by a "shift" of bit 5.

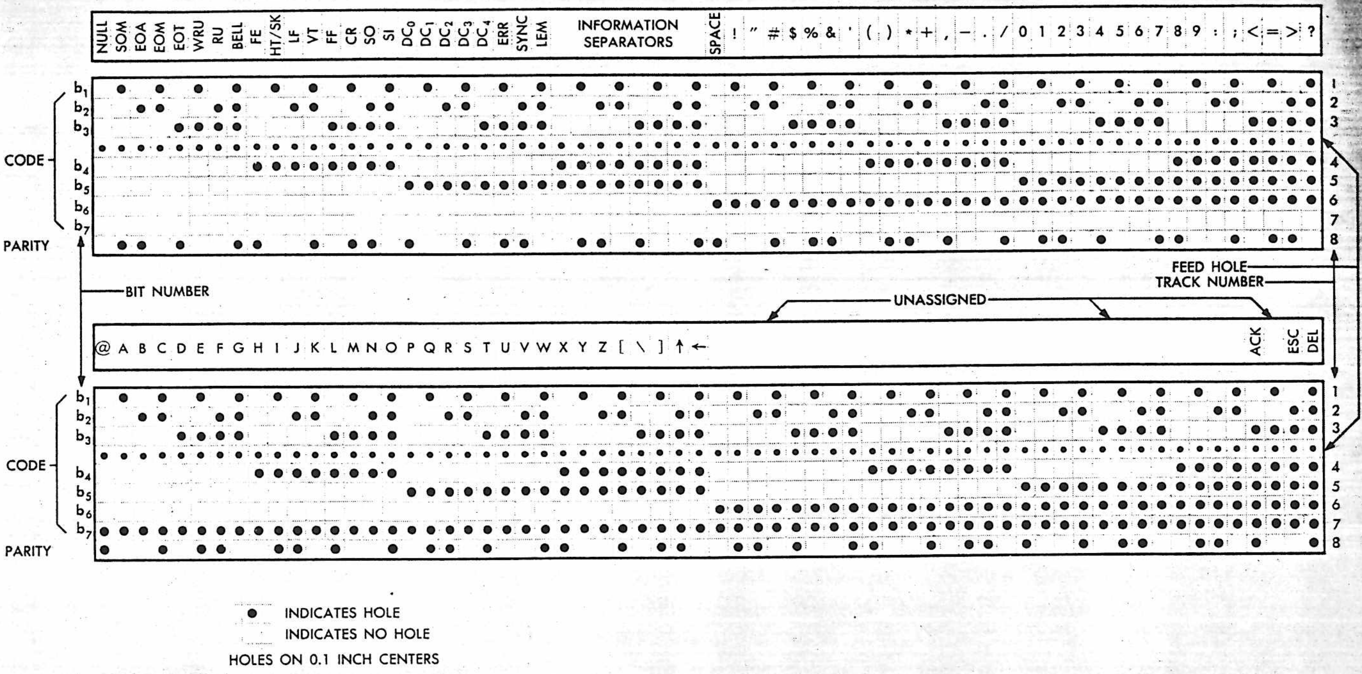
5	4	3	2	1	7: 0 6: 0	7: 0 6: 1	7: 1 6: 0	7: 1 6: 1
0	0	0	0	0	NULL	SPACE	@	UNASSIGNED
0	0	0	0	1	SOM	!	A	
0	0	0	1	0	EOA	"	B	
0	0	0	1	1	EOM	#	C	
0	0	1	0	0	EOT	$	D	
0	0	1	0	1	WRU	%	E	
0	0	1	1	0	RU	&	F	
0	0	1	1	1	BELL	'	G	
0	1	0	0	0	FE$_0$	(	H	
0	1	0	0	1	HT/SK	)	I	
0	1	0	1	0	LF	*	J	
0	1	0	1	1	V$_{TAB}$	+	K	
0	1	1	0	0	FF	,	L	
0	1	1	0	1	CR	−	M	
0	1	1	1	0	SO	.	N	
0	1	1	1	1	SI	/	O	
1	0	0	0	0	DC$_0$	0	P	
1	0	0	0	1	DC$_1$	1	Q	
1	0	0	1	0	DC$_2$	2	R	
1	0	0	1	1	DC$_3$	3	S	
1	0	1	0	0	DC$_4$	4	T	
1	0	1	0	1	ERR	5	U	
1	0	1	1	0	SYNC	6	V	
1	0	1	1	1	LEM	7	W	
1	1	0	0	0	S$_0$	8	X	
1	1	0	0	1	S$_1$	9	Y	
1	1	0	1	0	S$_2$	:	Z	
1	1	0	1	1	S$_3$	;	[	
1	1	1	0	0	S$_4$	<	\	ACK
1	1	1	0	1	S$_5$	=	]	
1	1	1	1	0	S$_6$	>	↑	ESC
1	1	1	1	1	S$_7$	?	←	DEL

1950s, represented a major improvement over prior pactices, but on analysis it too exhibited deficiencies in natural collating order and caused problems when used with foreign alphabets containing more than twenty-six characters.

Consequently the group turned its attention to the development of an appropriate code proposal. After several months of trying without success to adopt a sixty-four character code having a six-bit structure, the group settled upon a seven-bit set of 128 character capacity. Agreed upon late in 1961, this set was subsequently revised in the spring of 1962 to meet some recent European requirements. It is this seven bit code which was approved as an American Standard this summer and has successfully completed the first of two formal steps toward international standardization under the auspices of the International Standards Organization.

The New Code

As presently approved the ASCII code is not a complete standard. Its representation is media such as punched tape, magnetic tape, and punched cards is currently being defined by the same group that developed the code. The drawing on this page shows the code in (binary) arithmetic order; the value of the permutation increases


NULL SOM EOA EOM EOT WRU RU BELL FE HT/SK LF VT FF CR SO SI DC0 DC1 DC2 DC3 DC4 ERR SYNC LEM
INFORMATION SEPARATORS
SPACE ! " # $ % & ' ( ) * + , - . / 0 1 2 3 4 5 6 7 8 9 : ; < = > ?
b1 b2 b3 b4 b5 b6 b7
CODE
PARITY
1 2 3 4 5 6 7 8
FEED HOLE
TRACK NUMBER
BIT NUMBER
UNASSIGNED
@ A B C D E F G H I J K L M N O P Q R S T U V W X Y Z [\ ] ↑ ←
ACK ESC DEL
INDICATES HOLE
INDICATES NO HOLE
HOLES ON 0.1 INCH CENTERS

A rendering of the 8-level teletypewriter tape. Present Bell System usage is to make the eighth track always marking. Optional vertical parity in the eighth track will accord with this drawing.

from 0000000 (binary zero) to 1111111 (binary 127). For convenience, the permutations are divided into four columns, with the five low order binary digits (bits) on the left side and the two high order bits at the top. This representation clearly shows the binary relationships of the characters within the code.

The two center columns of the code contain printing graphics. The first character is SPACE, the "word separator," which can be thought of as an "invisible graphic." Following SPACE in ascending binary order is a set of special symbols, the ten decimal digits, a group of six more special symbols, and finally the alphabet. In total, sixty-four printing graphics are provided so that all the sixty-four permutations of a 6-bit binary computer could, for instance, be interchanged without fear of the inadvertent generation of significant control characters. These graphics were placed in the center two columns so as not to conflict with the peculiar requirements which transmission systems place on the "NULL," or "all 0's," combination, and the equal restrictions placed on the "all 1's" combination (DELETE) by its use as a rub-out in punched tape.

After the position of the graphics was picked, approximately one-half the remaining permutations were assigned to control functions; the remainder have not as yet been assigned. The use of this unassigned area is now being debated between those who would like to use it for additional graphics, particularly a lower case alphabet, and those who see a need for additional control characters.

Logical Design

Every effort was made to design the set logically. To the extent possible, like classes of characters were placed in contiguous binary areas so they could be recognized by examination of a minimum number of bits or through simple arithmetical tests. Punctuation marks (or special symbols) were placed at the beginning (low binary end) of the 64 character graphic subset since punctuation needs usually come before digits and alphabetical characters in listing information, ROY, C. comes before ROYAL, C. in the telephone directory, a simple example of comma (,) preceding O in order. The alphabet was placed in one-half of the six bit graphic subset to simplify its identification. This logical structure facilitates data sorting and grouping. The location of the alphabet within its five bit (32 character) frame was dictated primarily by the desire to accommodate more than twenty-six alphabetical characters, a necessity in certain European languages. The chosen placement permits the addition of up to 5 alphabetic letters following the character Z.

To facilitate this substitution the five characters placed in those positions are of secondary importance. International acceptability was one of the prime targets in the code's design. To faciliate machine arithmetic, the decimal digits were coded so that their four low-order bits represent the binary equivalent of the decimal value. Thus the bits b_4 through b_1 of the digit "zero" are 0000 and of the digit "nine," 1001.

Placing Special Symbols

Great care was taken in the placement of the special symbols. The most natural human collating order was reduced to a binary order, permitting low-cost collating by arithmetic instead of "table look-up" techniques. Not only were the common special symbols (! through /) assigned a lower binary value than the digits to provide an ordering or collating sequence (Symbols, Digits, Alphabetics) compatible with normal human usage, but also care was taken that no symbols important today in collating schemes should lie between the numerical and alphabetical fields. In this way the alternative collating sequence, Symbols, Alphabetics, Digits, which is also used quite widely today, can be obtained within a processor through a simple "Exclusive OR" device in logic.

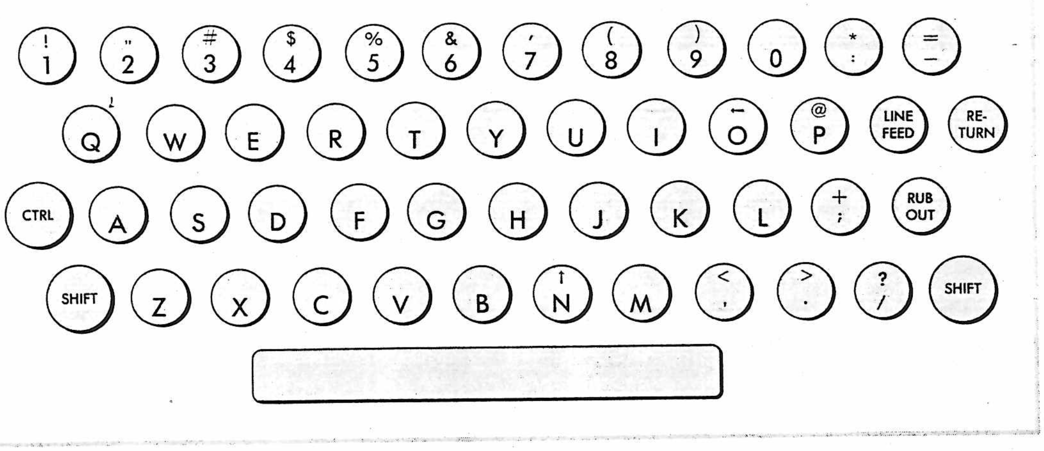
The symbols, colon and semicolon, considered less important than many of the other symbols, were placed so they could be replaced by "10" and "11" in Sterling monetary areas where use of the single digits 10 and 11 for English pence is common. The symbols in the upper half of the second column were assigned to facilitate pairing of symbols and numerals on teletypewriter keys. Note that the symbol (″) can be generated by the same key as the numeral 2, and (%) by the same key as 5—quite like the ordinary typewriter—by a simple change, or "shift," in the state of bit b_5.

Contracting The Set

The symbols also were placed so as to simplify the seven-bit set's relation to a preferred European six-bit computer set. In fact the whole set can be contracted in a regularized manner. If bit $_6$ or b_7 is ignored a large variety of six-bit sets can be obtained for possible internal use in equipment. One such set might be the pure graphic subset contained in the center two columns; another would be similar but with the substitution of LINE FEED and CARRIAGE RETURN for the symbols asterisk (*) and hyphen (-). By slightly more complex contractions, involving the manipulation of bit b_5, still other six bit sets can be obtained. The flexibility afforded designers of six-bit processors is great, and it is not at the expense of a uniform data interchange convention.

Further, by striking out bits b_5, b_6 and b_7, a very neat four-bit subset, indicated in the drawing on page 397 and containing not only the decimal digits but also a very useful set of punctuation marks, is obtained. This latter set should prove handy for cash registers and other basically numeric-only devices. Similar considerations for expansion to an eight-bit set contributed to the design of the code.

A fundamental means of departure from the basic set is provided by the ESCAPE. While the use of this character has not yet been officially defined,



The arrangement of characters under the new code on the four-row typewriter-style keyboard.

it is conceived of as indicating that the data which follows is not in the standard code. This feature will be very useful since no finite set of characters can ever anticipate the variety of problems to be faced in the future. The definition and identification of alternate domains into which the coded system "escapes" is the subject of current standardization activity.

The column of controls can be viewed as providing essentially four equal sized groups of characters. The first eight, NULL through BELL, are useful to the communicator. The second group of eight consists of the "format effectors" which, like LINE FEED and TABULATE, organize printed data on a page. The third group, in addition to providing controls for operating auxiliary apparatus, contains signals to (1) indicate an error in data (ERR), (2) provide a synchronizing pattern for use by synchronous communication terminals (SYNC) and (3) indicate the end of useable information (LEM-"Logical End of Medium" as in "end-of-card"). These second and third groups are equally useful to the communicator and the data processor. The final group of eight controls provides the data processor with data delimiters useful in structuring data into a hierarchical relationship such as ITEM, RECORD, FILE.

Conflicting Requirements

It might be thought from this simple recitation of the features of the code that its generation was straightforward. This was not the case. There were typewriter requirements and computer requirements, card equipment requirements and magnetic tape equipment requirements, programming and hardware requirements, transmission requirements and collating requirements. In addition there were military, domestic, and international requirements. These needs conflicted and the only solution was compromise. The code in the drawing on page 397 appears to be an almost ideal compromise between the conflicting requirements. One "requirement" it does not meet; it breaks completely with the past. It is quite incompatible with both the CCITT No. 2 alphabet and its derivatives, widely used in communications, and the punched card code used extensively in tabulating machinery. It looks to the future.

In 1962 the Bell System Teletypewriter Exchange Service (TWX) was converted from manual to dial operation. (RECORD, *July-August* 1962) A new transmission arrangement which accompanied this conversion made possible the introduction of a 100 word per minute service to compliment the existing 60 words per minute operation.

Since the majority of the teletypewriters in service were Model 15 units incapable of speeds in excess of 75 wpm, any move to the higher speed presaged the replacement of these units. But if they were to be replaced, why not escape from the limitations of the 5-level code and its 3-row keyboard? Now, if ever, seemed the time to take such a step.

Decision Made

So the decision was made. Thereafter, it remained only to pick the code and alphabet on which the new machines would operate. It was in this environment that the Bell System joined the code standardization effort late in 1960 and adopted the conclusions of the standardization work as rapidly as formulated.

Owing to the needs of its business, the Bell System has been forced to choose a punched tape representation of the code before a standard representation could be worked out. This tape representation is shown in the drawing on page 398. It is based on the simple idea that bit 1 of the code should lie in track 1 of the punched tape, and so on, through track 7. The 8th track is currently unused, being left constantly in the "marking" or "1's" condition. It will undoubtedly find future use as a parity bit.

This simple relationship between bit number and track number has been carried one step further. Since track 1 of a punched tape is traditionally transmitted first in time, bit 1 of the code becomes impulse No. 1 of the transmitted teletypewriter signal. This compatible numbering system will be of the greatest value in training of personnel, in analysis of errors, and in simplifying maintenance and operating practices. For keyboard use, too, the code has worked out well. The keyboard, as shown in the drawing on page 399, differs only slightly from the one widely used in office typewriters today.

The code is beginning to find accelerated acceptance in the industry. Some users generally the smaller one, may feel that there is no need to change their existing practices since their operations are primarily in one location. In such instances no change should be expected until some other need, such as lower cost, expansion or replacement of their data facilities provides the opportunity for change. But the larger users are finding its promise of uniformity attractive. It is not too much to expect that the new code will be in extensive use throughout the world within the next decade.

Report of Meeting No. 8, Task Group X3.2.4

December 17 and 18, 1963

BEMA Headquarters, New York City

ATTENDANCE:

Present December			
17	18	H. Spielman, Chairman	RCA
17	18	O. R. Arne	Mergenthaler Linotype
17	18	J. B. Booth	Teletype
	18	P. G. Charest (observer)	NAVCOSSACT
17	18	E. H. Clamons	UNIVAC
17	18	C. J. Davis	IBM
17		W. F. Emmons	IBM
17		R. F. Ewald	BTL
	18	L. L. Griffin	Navy
	18	G. V. Hawkins	IBM
17	18	W. F. Huf	Navy
	18	J. D. Keen	UNIVAC
17	18	D. A. Kerr	BTL
17	18	W. Y. Lang	BTL
17	18	J. L. Little	NBS
17		J. B. Macfarlane, X4A1	IBM
	18	C. E. Mackenzie	IBM
	18	G. E. Mistos	SCM-Kleinschmidt
17	18	R. F. Mundy	GSA
17	18	J. K. Nelson	WU
	18	L. A. Tate	IBM
17	18	H. Tholstrup	Friden
17	18	L. R. Turner	NASA
	18	H. C. Umstead	USAELRDL
17	18	E. F. Vidro	Xerox
17	18	A. L. Whitman	ITT Comm. Systems
17	18	W. J. Zehner	IBM

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NMAH 310/4

1. Documents Distributed:

Doc. No. (X3.2.4-)	Description
1	Memo. to X3.2.4, ASCII Control Character Definitions, by C. J. Davis and W. J. Zehner, 17 Dec. 1963.
2	Comments on Certain Control Characters and Their Location in the Code Table, L. L. Griffin, 11 Dec. 1963.
3	Draft, Letter of Transmittal, To Chairman X3.2 from Chairman X3.3, transmitting exhibits on ASCII Controls, 11 Dec. 1963.
4	Check List of Control Character Symbol and Status of Definitions, J. L. Little, 16 Dec. 1963.
5	DCA Memo. for Record, Subject: Communication Control Characters Utilizing the ASCII Code in AUTODIN, by Theodore Knight, 14 Nov. 1963.
6	Draft, Dual vs Single Alphabetic Code Assignments, J. L. Little, 12 Dec. 1963.
7	ASA Letterhead Memo. to X3.2.4, X3.2 and Chairman X3.5, Legend and Glossary for Control Characters, A. L. Whitman, 22 Nov. 1963.
8	Schematic Diagram of Data Message Format, A. L. Whitman, 10 Dec. 1963.
9	Memo to Members X4-AIE, Keyboard Arrangements, J. B. MacFarlane, 4 Dec. 1963.
10	Tableau de Code A. 7 Elements. (7-Bit Set Table.) ISO Proposal (date added, "31 Oct 1963").
11	Attendance List, X3.2.4, 17 Dec. 1963.
12.	Clamons Code Proposal dated 17 Dec. 1963.
13	Memo, "On the Proposal to Include the Diacritical Mark 'Tilde' in the International 7-Bit Code Set," D. A. Kerr, 17 Dec. 1963.

2. The Chairman asked for a volunteer to be permanent secretary of X3.2.4. Allen Whitman agreed to assist in recording at meetings, and Jack Little agreed to be Secretary.

3. Mr. Kerr and Mr. Little gave a report of an X3.3.4 (End-to-End Controls) meeting held at BEMA on December 9, 1963, attended by Mr. Kerr, Mr. Whitman, Mr. Little from X3.2.4, with Mr. Mundy as observer, and in part by Mr. Emmons representing X3.3.3. Task Group X3.3.3 was present in the afternoon.

   The joint meeting proved to be very valuable in that most of the apparent conflict between control function definitions as set forth in X3.3.4's "Tutorial Paper on Functional Requirements of Control Procedures for Data Transmission" and those developed recently by X3.2.4, turned out to be semantic in nature.

   Much of the reconciliation has been documented by X3.3.4 and appears in the documents of December 11, 1963, identified as X3.2.4-3.

   There was a discussion of the X3.2.4-3 document and a related paper submitted by Davis and Zehner of IBM. The action on these reports took the form of the following resolution:

   > Resolved that X3.2 should transmit an inquiry to X3.4 (Programming Languages) asking for guidance on number, needs and uses of single-character information separators of ASCII, and suggested definitions, with the suggestion that the number of these information separators be kept to a minimum.

4. A report of the Ad Hoc Committee from X3.2.4 and X4-ALE on Underscore and Diacriticals was given by J. B. Booth, L. R. Turner, J. B. Macfarlane, Eric Clamons and W. F. Huf. This Ad Hoc Committee had made a serious attempt to reconcile the conflicts presented by:

   a. ASCII in its existing form,

   b. The ISO/TC97/SC2 7-bit code table with underscore, five diacritical marks and several national-usage areas. (Document X3.2.4-10 or 10A),

   c. De facto keyboard arrangements (Document X3.2.4-9),

   d. Desirability of pairing "repeatable" symbols on electric typewriter keyboards,

   e. Desirability of pairing symbols having similar surface area on electric typewriters of the type-bar type,

   f. Minimizing the confusion possible when receiving dual-case information on a monocase printer. This suggests that the diacriticals, underscore, and any other "backspace" graphics should preferably be located in the center four columns

   There was a clear desire from X4-ALE to pair underscore with hyphen and quotation marks with apostrophe, not only on keytops for compatibility with the BEMA standard 42-key electric typewriter keyboard, but in code table assignments in order to preserve the criterion of shifting by means of a single-bit inversion.

   Mr. Macfarlane indicated that the keytop and printing requirements could be met, starting with the BEMA standard electric typewriter keyboard if the shapes of the apostrophe and quotation marks were altered so as to serve alternately as accent ague (acute) and dieresis respectively, and two additional keys be provided to supply accent grave under circumflex, and numeral one under tilde.

   Mr. Booth emphasized that no simple coding change could accommodate the single-bit inversion type of shifting for the underscore-hyphen and apostrophe-quotation mark pairing, and a considerable amount of the ensuing discussion centered around this point.

   It was generally agreed that the "number sign" (paired with numeral three) which is widely used in data processing, is more valuable than the exclamation point, and that therefore the tilde should preferably be shown as a contending substitute for exclamation point, which is paired with numeral one, in the international 7-bit code table.

5. After considerable discussion of the above factors, a series of motions were voted upon, with a prefacing statement, moved by Mr. Zehner, seconded by Mr. Turner, as follows:

   > As a preable to the resolutions of December 17 and 18, 1963 pertaining to graphics, X3.2.4 memorializes X3.2 that X3.2.4 is opposed to changes in ASCII at this time and that these resolutions be used only as guidance in the preparation of the ISO proposal.

   The vote was 8 for, none against, one abstaining.

6. A series of motions concerning various placements of underscore, at-sign, equal sign and the diacriticals were defeated, except for the following, relating to the ISO 7-bit code table:

   a. Underscore should be above capital A.

   b. At-Sign should be above small a.

   c. Support the assignment of circumflex in place of up arrow, and accent grave in place of left arrow.

   d. Question the inclusion of tilde, but if required, recommend the position now occupied by exclamation point.

7. An ad hoc committee, comprised of Messrs. Clamons, Arne, Davis, Lang and Turner, was formed to consider the three positions following lower case z in the ISO draft proposal. X3.2.4 voted to recommend:

   a. CRITERIA

      1. Consistency of meaning when the last two columns are folded over the preceding two columns.

      2. High utility factor in general use (human communication).

      3. Avoid the assignment to the last two columns of symbols used for over-printing (in general use).

   b. It is suggested that the three positions following lower case z be: left brace, vertical line, right brace.

   c. U.S. delegation be instructed to request "exclamation point" in place of "vertical line" if "tilde" replaces the"exclamation point" in the ISO draft proposal.

8. It was unanimously agreed that "backspace" should be defined:

> "On a printing device, the BKSP character causes the printing point to move one character position to the left relative to the printable surface."

J. L. Little

John L. Little,
Secretary, X3.2.4